REVISION "A"
OPERATING AND MAINTENANCE MANUAL
for the
AL-51D
SPECTRUM ANANLYZER

Texscan
INSTRUMENTS

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SPECTRUM ANANLYZER

P/N 001-014

TEXSCAN CORPORATION
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Indianapolis, Indiana 46226

317/545-4196

TABLE OF CONTENTS

INTRODUCTION	1
SPECIFICATIONS	2
CIRCUIT DESCRIPTION	5
Block Diagram (figure)	4
OPERATING PROCEDURE	13
Controls Location (figure)	12
Warnings & Notices	13
Controls	13
Initial Setup & Calibration Check	18
APPLICATIONS	21
Scan Loss	21
Frequency Identification	21
Amplitude Measurement	23
Spectral Purity	24
Orienting Antennas	24
Amplitude Modulation	24
Test & Alignment of Frequency converters	25
Oscillator Test & Alignment	26
Signal Strength Measurements	28
Cross Modulation Measurement	30
ALIGNMENT/CHECKOUT	31
PHOTOGRAPHS	P1
PARTS LIST	36
SCHEMATIC	
DS-9 (option)	
WARRANTY REGISTRATION CARD	

INTRODUCTION

The AL-51D Spectrum Analyzer will be referred to as either the "Unit" or the "Analyzer" in this manual. It is a general purpose, high reliability instrument designed for making rapid signal strength measurements in the.4 MHz to 1000 MHz range. The Unit is completely portable at under 30 pounds, and can operate off its own internal rechargeable batteries, the included Power Supply/Charger (PS/C-10), or from an external 12--15 volt DC source, including a 12 volt vehicle with negative ground. It has a protective case, carrying handle, and soft case with strap to facilitate field operation in almost any conditions.

The Unit displays signals over a 70 dB dynamic range, handling levels as low as -100 dBm. You can make relative amplitude measurements in seconds. A manual sweep mode allows amplitude measurements where it is necessary to integrate the modulation for more accurate readings of signal strength. You can make measurements within ±2 dB simply, swiftly, and reliably. Under hospitable environmental conditions, the internal battery supports over 3 hours of continuous operation; 12 hours of intermittent operation are possible between charges, if you are careful in the operation.

You can easily identify frequencies within ±100 kHz by using the center frequency slide rule dial combined with the frequency markers. Amplitude measurements can be made over a 130 dB range using the input attenuation and the 70 dB on-screen dynamic range.

NOTE: PLEASE REFER TO THE OPERATION SECTION FOR **WARNINGS AND CAUTIONS** BEFORE POWERING THE UNIT OR ATTEMPTING TO USE IT.

SPECIFICATIONS

FREQUENCY SPECIFICATIONS

Range:	.4 MHz to 1000 MHz
Calibrated Dispersion:	2, 20, and 200 kHz/division, and 1, 10, and 100 MHz/division ±10% -- continuously variable and CW.
Accuracy:	Dial accuracy is ±10 MHz, typically ±5 MHz.
Stability (Drift):	After 10 minute warm-up, typically 30 kHz/minute when not phase locked. After 1 hour (and with phase lock on), typically 10 kHz/minute.
Residual FM:	Less than 20 kHz p-p, less than 500 Hz p-p, phase locked.
Noise Sidebands:	More than 50 dB below CW signal level 15 kHz or more away from carrier.
Input Impedance:	50 ohms, return loss greater than 18 dB for input attenuator settings of 10 dB or more, using a BNC input connector.
Frequency Markers:	1, 10, and 50 MHz.
Marker Accuracy:	±0.01%
Resolution:	IF bandwidths are 200 kHz, 10 kHz, and 0.5 kHz at the 3 dB points. The 60 dB/3 dB ratio at 200 kHz and 10 kHz is 20/1; at 0.5 kHz, it is 4/1.

AMPLITUDE SPECIFICATIONS

Measurement Range:	-100 dBm to +30 dBm at 200 kHz resolution.
Average Noise Level:	-102 dBm at 200 kHz resolution, with video filtering.
Frequency Response:	With the input attenuator set at 10 dB, the frequency response including the input attenuator is ±2.0 dB from 10 MHz to 1000 MHz.
Amplitude Display	Relative amplitude accuracy for 60 dB range is ±2.0 dB (not including frequency response error).
Graticule Marking:	On the **right** side of the graticule-- 70 dB log scale calibrated in dBm (-100 dBm to -30 dBm) and 12 dB log scale calibrated in dBm (-92 dBm to -80 dBm). On the **left** side of the graticule-- a linear scale calibrated at 100%, 75%, 50%, and 25%.
Residual Responses:	Less than -100 dBm with no signal input, from 10 to 1000 MHz.
Attenuation:	Up to a maximum of 70 dB in 1 dB steps.
Gain Compression:	-20 dBm input, +10 dB RF input attenuation creates 1 dB of compression.
Video Filter:	Post-detection filter used to average the noise. Switch-selected 1 kHz and 10 Hz bandwidth.
Cal Out:	54 MHz (.005%) at -40 dBm (±.25 dB at 75°F, and ±.75 dB over operating temperature range).

DISPLAY

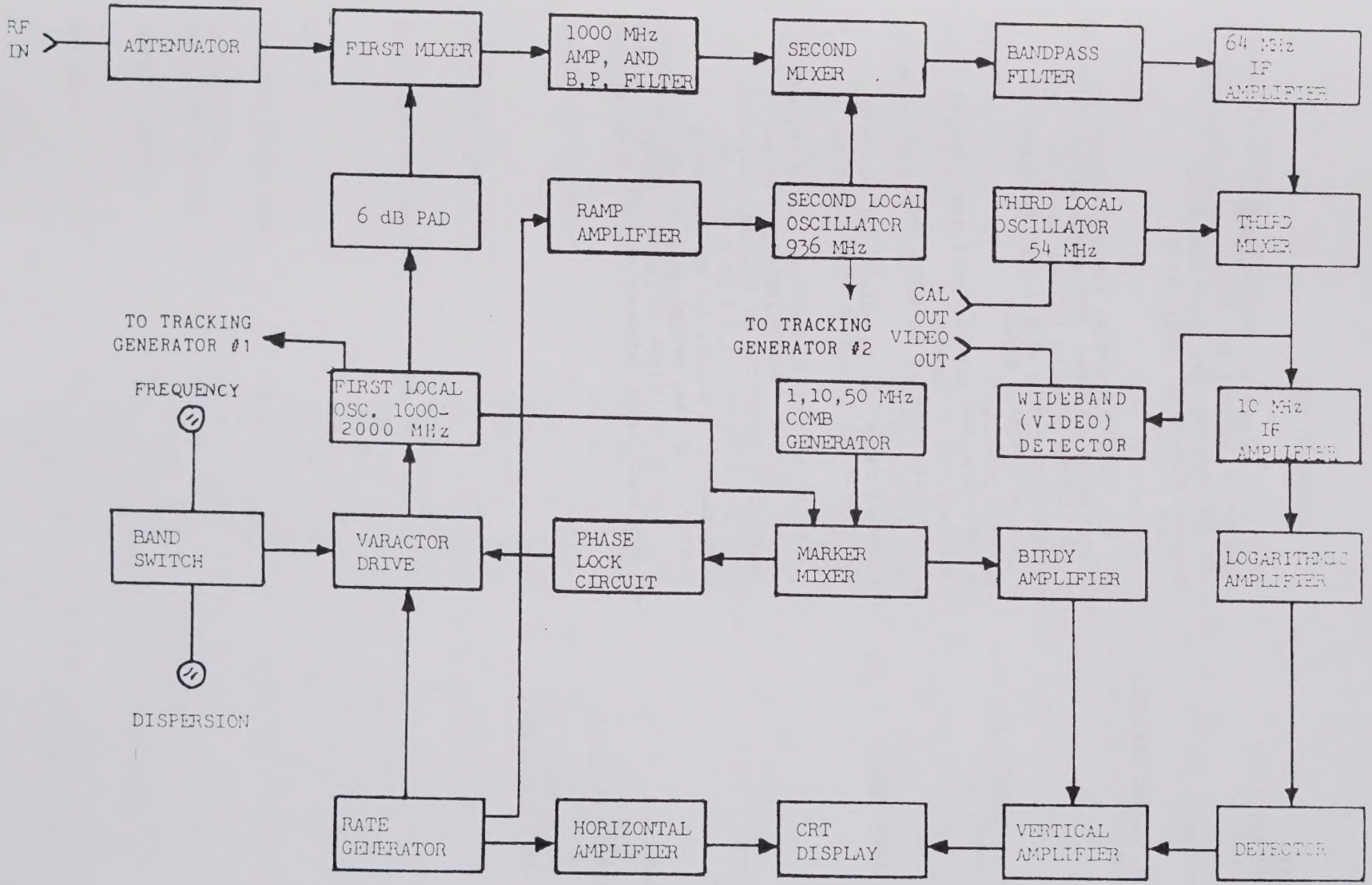
Cathode Ray Tube:	4000 volt potential, P40 phosphor.
Graticule:	Approximately 2" X 4". 8 X 10 divisions with 5 subdivisions per major division.
Screen Bezel:	Accepts Tektronix® camera mount.

GENERAL CHARACTERISTICS

Intermodulation Distortion:	For two -40 dBm signals, the third order is down 60 dB or more. The second order of two -40 dBm signals is down by 50 dB. The second order of a single -40 dBm signal is down by 55 dB or more.
Local Oscillator Outputs:	-10 dBm, minimum.
Audio Recovery:	AM/NBFM detector with 0.1 watt audio output to internal 3" speaker.
Sweep Rate:	Rate is continuously variable from 0.03 to 30 Hz, and manual.
Temperature Range:	Operating range +20 to +100°F (-7 to +38°C. Storage range is -30 to +140°F (-34 to +60°C).
Power:	Internal batteries, external +12 to +15 VDC at 2.0 amperes. Approximately 3 hours continuous operation on internal batteries.
Dimensions:	8.5" X 14" X 14.6" (21.6 X 35.6 X 37 cm).
Weight:	Approximately 33 pounds (15 kg) including battery. Battery weight is 6 pounds (2.7 kg). Shipping weight 40 pounds (18 kg).
Video Out:	-40 dBm input level produces +1 volt output.

ACCESSORIES (Included)

Manual
Charger/Converter
Automobile Power Cable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SECOND MIXER
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64 MHz IF AMPLIFIER
6 dB PAD
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BAND SWITCH
VARACTOR DRIVE
PHASE LOCK CIRCUIT
MARKER MIXER
BIRDY AMPLIFIER
LOGARITHMIC AMPLIFIER
DISPERSION
RATE GENERATOR
HORIZONTAL AMPLIFIER
CRT DISPLAY
VERTICAL AMPLIFIER
DETECTOR

CIRCUIT DESCRIPTION

Refer to the block diagram and schematic for additional information as you read the following information.

ATTENUATOR

The RF attenuator allows you to reduce input signals by 0-70 dB in steps of one dB.

CAUTION: The input to the attenuator must not exceed 1 watt average and the output of the attenuator must not exceed 1 milliwatt average.

FIRST LOCAL OSCILLATOR

This voltage-tuned oscillator can be set for either a swept or CW output in the 1000 to 2000 MHz range. A front panel SMA connector output of -10 dBm is provided to drive an (optional) tracking generator.

FIRST MIXER

The first mixer is of the double balanced type, using four matched Schottky barrier diodes configured as a ring modulator. The input and output circuits are connected through special wideband transformers designed for this purpose. The output of the first mixer is 1000 MHz coupled to the input of the 1000 MHz amplifier.

1000 MHz BANDPASS FILTER AND AMPLIFIER

The bandpass filter selects the 1000 MHz frequency component in the mixer output, and the 1000 MHz amplifier provides approximately 20 dB of gain.

SECOND LOCAL OSCILLATOR

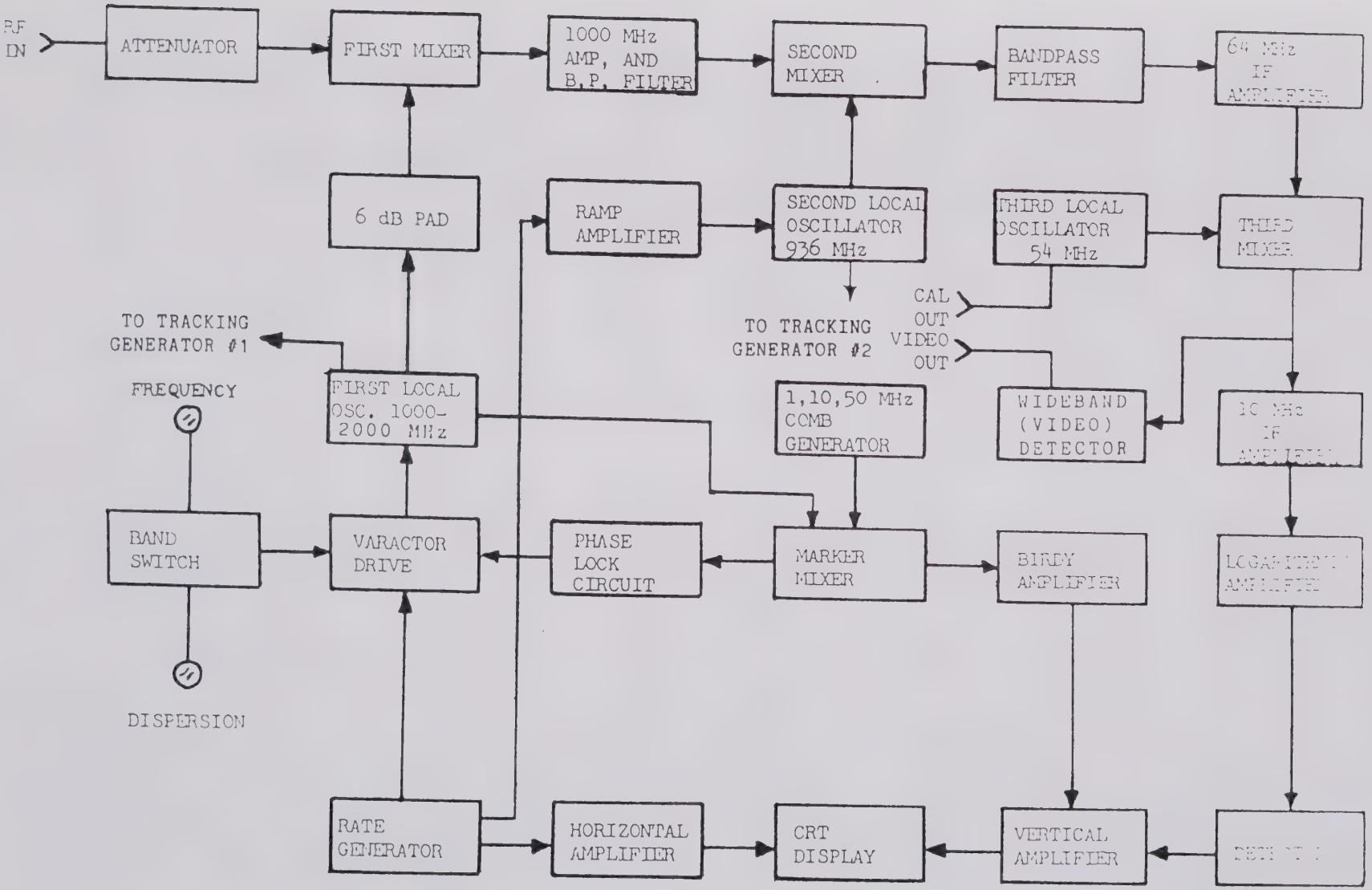
The second L.O. is a stable, tuned line oscillator operating at a center frequency of 936 MHz. The output of this second L.O. is coupled to the second mixer. In narrow dispersion modes, the second L.O. is swept by an amplified ramp derived from the rate generator. This ramp signal varies the capacitance of the second L.O. transistor. A front panel SMA connector output of -10 dBm, is provided to drive the tracking generator option.

SECOND MIXER

The output of the second L.O. and the filtered output of the first mixer are heterodyned in the second mixer to produce an output of 64 MHz. The output of the second mixer is filtered to remove unwanted responses, and the 64 MHz output is coupled to the second IF amplifier. This amplifier is a transistor circuit with a low noise figure.

64 MHz IF AMPLIFIER

The IF stage is a single integrated circuit amplifier. Both the input and output are tuned to 64 MHz. The gain of the amplifier is adjustable over a 6 dB range from the front panel AMPL CAL control.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THIRD LOCAL OSCILLATOR AND CAL OUT

The third L.O. is a crystal-controlled transistor oscillator operating at 54 MHz. The output of the third L.O. is coupled to one input of the third mixer. The output of the 54 MHz oscillator is also coupled to the CAL OUT connector on the front panel. It provides a calibrated -40 dB signal level for amplitude calibration.

THIRD MIXER AND IF AMPLIFIER

The third mixer is a balanced mixer combining the 64 MHz output of the second IF and the output of the third L.O.. The result is amplified by a transistor circuit with a tuned output of 10 MHz and a 200 kHz bandwidth.

LOGARITHMIC AMPLIFIER

The logarithmic amplifier is a monolithic integrated circuit consisting of two parallel 35 dB log amplifier stages that are summed into differential outputs. The output is proportional to the sum of the logs of the input voltages to the two stages. The input signal from the 10 MHz IF amplifier is split between two limiting integrated-circuit amplifier stages that drive the logarithmic amplifier. The output of the logarithmic amplifier drives the detector amplifiers.

DETECTOR

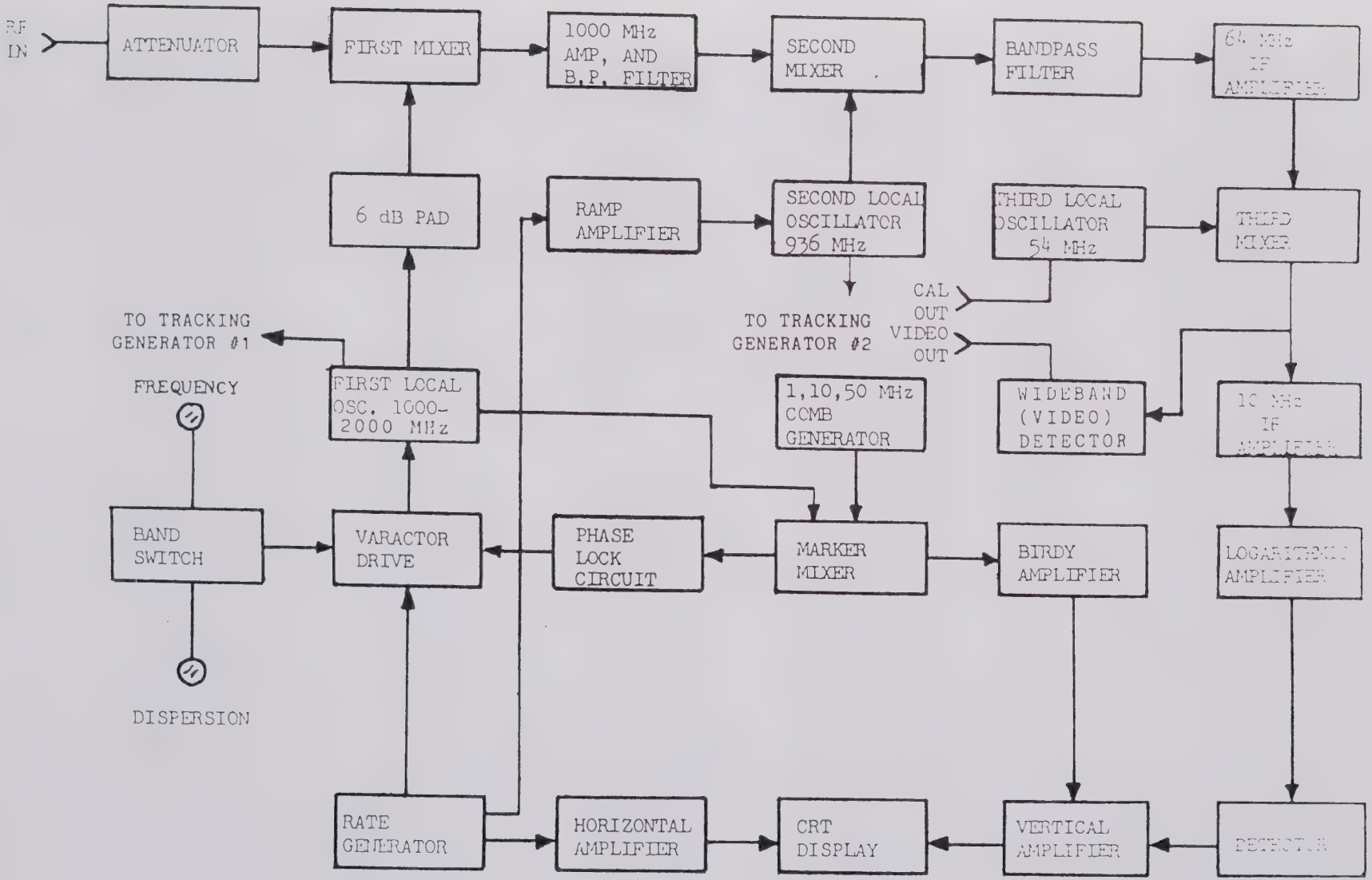
The detector input consists of two differential-input, differential-output integrated circuit amplifiers. Each IC drives a pair of hot-carrier diodes used as linear detectors. Their two outputs are added, and the combined output drives the vertical amplifier. The front panel LOG range switch selects either the 12 dB or 70 dB detector output range, each of which is obtained from a calibrated internal voltage divider. A linear detector mode is also provided.

VERTICAL AMPLIFIER

The vertical amplifier uses two operational amplifiers to drive a complementary pair of output transistors which drive the CRT's vertical deflection coil. A portion of the vertical output is sampled and fed back to the IC drive circuitry for gain stabilization.

RATE GENERATOR

The rate generator uses a pair of integrated operational amplifiers to generate the timed waveforms driving the horizontal amplifier and varactor drive circuits. Two modes of sweep operation may be selected using the front panel AUTO/MAN switch. When the AUTO/MAN switch is in AUTO, the horizontal sweep rate is continuously variable from .3 to 30 Hz, or .03 to 3 Hz. The rate of .03 to 3 Hz is obtained by pulling the RATE/MAN control into the DIVIDE BY 10 position. When the AUTO/MAN switch is at MAN, the horizontal position of the trace is varied by rotating the RATE/MAN control.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VARACTOR DRIVE

The varactor-drive circuit controls the voltage to the varactor diodes in the first local oscillator. It consists of two integrated circuit amplifiers. The amplifier input consists of two additive voltage components, a DC component determined by the settng of the front-panel FREQUENCY control and the dispersion switch, and a triangular-wave component determined by the front panel DISPERSION switch. The triangular wave is derived from the rate circuit. In phase-lock operation, the output of the phase lock circuit is coupled to the second amplifier stage.

The varactor-drive output voltage determines varactor diode capacitance which, in turn, determines the frequency of the first L.O.. The varactor drive is adjusted to provide a linear oscillator frequency characteristic on the CRT display.

HORIZONTAL AMPLIFIER

The horizontal amplifier consists of an operational amplifier driving a complementary pair of output transistors which, in turn, drive the horizontal deflection coil of the CRT. Part of the horizontal deflection signal is fed back to the input of the operational amplifier for gain stabilization.

1, 10, 50 MHz COMB GENERATOR

Three crystal-controlled harmonic markers (1, 10, and 50 MHz) are included in the Analyzer. The birdies derived by mixing the markers with a sample from the first local oscillator provide a precision method for monitoring frequency. The marker accuracy is 0.01% $\pm$1 MHz; the $\pm$1 MHz portion of the error can be minimized by centering the 0 MHz frequency marker at the peak of the zero resonse bell with the coarse and fine center frequency tuning controls. This should be done at 1 MHz/div dispersion using a 10 kHz IF bandwidth. Markers are only available when in dispersions of 200 kHz/div or greater. The 1 MHz marker is divided by five to provide a 200 kHz reference for the phase lock loop.

MARKER MIXER

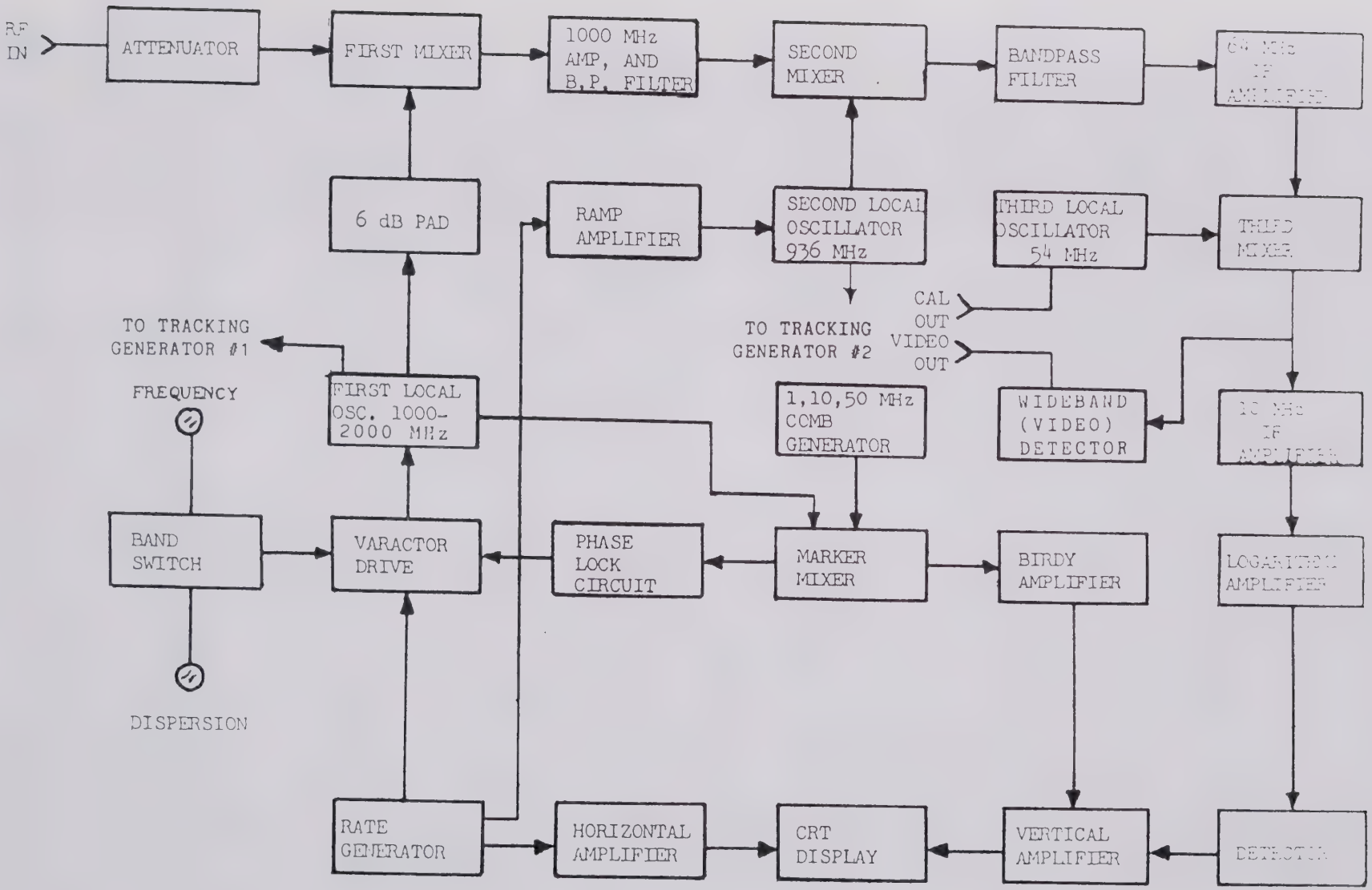
The output of the comb generator and the first local oscillator sample are heterodyned in the marker mixer. When the frequency of the first local oscillator is near a comb frequency multiple, a zero-beat (or birdy) is produced.

BIRDY AMPLIFIER

The birdy information developed in the marker mixer is amplified and shaped in the birdy amplifier. The output of the birdy amplifier is added to the log amp detector output in the vertical amplifier.

PHASE LOCK CIRCUITRY

The phase lock circuitry operates for dispersion settings of 200 kHz/div and less. The phase lock technique compares the frequency and phase of the first local oscillator to a 200 kHz reference oscillator. If the two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signals differ in frequency and/or phase, an error voltage is generated and applied to the 1st L.O., causing it to shift, decreasing the frequency difference. This correction continues until phase lock is achieved, after which the 1st L.O. will continue to track the reference. Because of the high frequency of the 1st L.O. (1 to 2 GHz), the phase sample cannot be developed directly. Instead, it is developed by heterodyning the 1st L.O. with the 1 MHz comb generator. The 200 kHz reference is obtained by dividing the 1 MHz comb reference by five.

LOW-VOLTAGE POWER SUPPLY & BATTERY SAVER CIRCUIT

The primary power for the Analyzer is an internal 12 VDC battery. The low-voltage power supply provides four regulated voltages, +11.3, +9.1, and two +5.7's, plus two other (derived) voltages, +19 and -3.5 VDC. The regulators drop the battery voltage to these required levels and maintain the regulated level against load fluctuations and input voltage variation due to battery discharge. The regulator circuits use operational amplifiers to drive the series pass regulator transistors. The charger/converter (see below) allows recharge of the internal battery and/or operation of the Analyzer from AC power. An INT BAT-OFF-EXT BAT front panel switch is provided to select the internal battery supply or an external 12 to 15 VDC 1.5 amp power source. The battery saver circuit automatically disconnects the battery when its voltage drops below 10 volts. This prevents complete discharge of the battery in order to extend the life of the battery.

HIGH-VOLTAGE POWER SUPPLY

The high-voltage power supply provides a regulated 4000 VDC to the CRT anode and control voltages to the various CRT elements. Operational amplifier circuitry and one transistor provide drive for the flyback transformer. A sample of the high-voltage is fed back to a series regulator circuit which controls the collector voltage of the flyback drive transistor. The variation of the drive-transistor collector voltage causes regulation of the high-voltage supply.

CHARGER/CONVERTER

A PS/C-10 battery charger/converter is provided with each Analyzer. It is powered from 115/125 60 Hz or 220/240 50 Hz power. The charger/converter must be set to match the line voltage; a switch is provided on the Unit for this. This is a switching power supply, fused at 3 amps output current, and capable of supplying up to 4 amps at +15 volts, for simultaneous operation and battery charging.

WIDE BAND DETECTOR

The third mixer output is coupled to the wide band detector module, where it is amplified and detected. The detected output is then processed through an offsetting IC stage and coupled to the front panel VIDEO OUT connector.

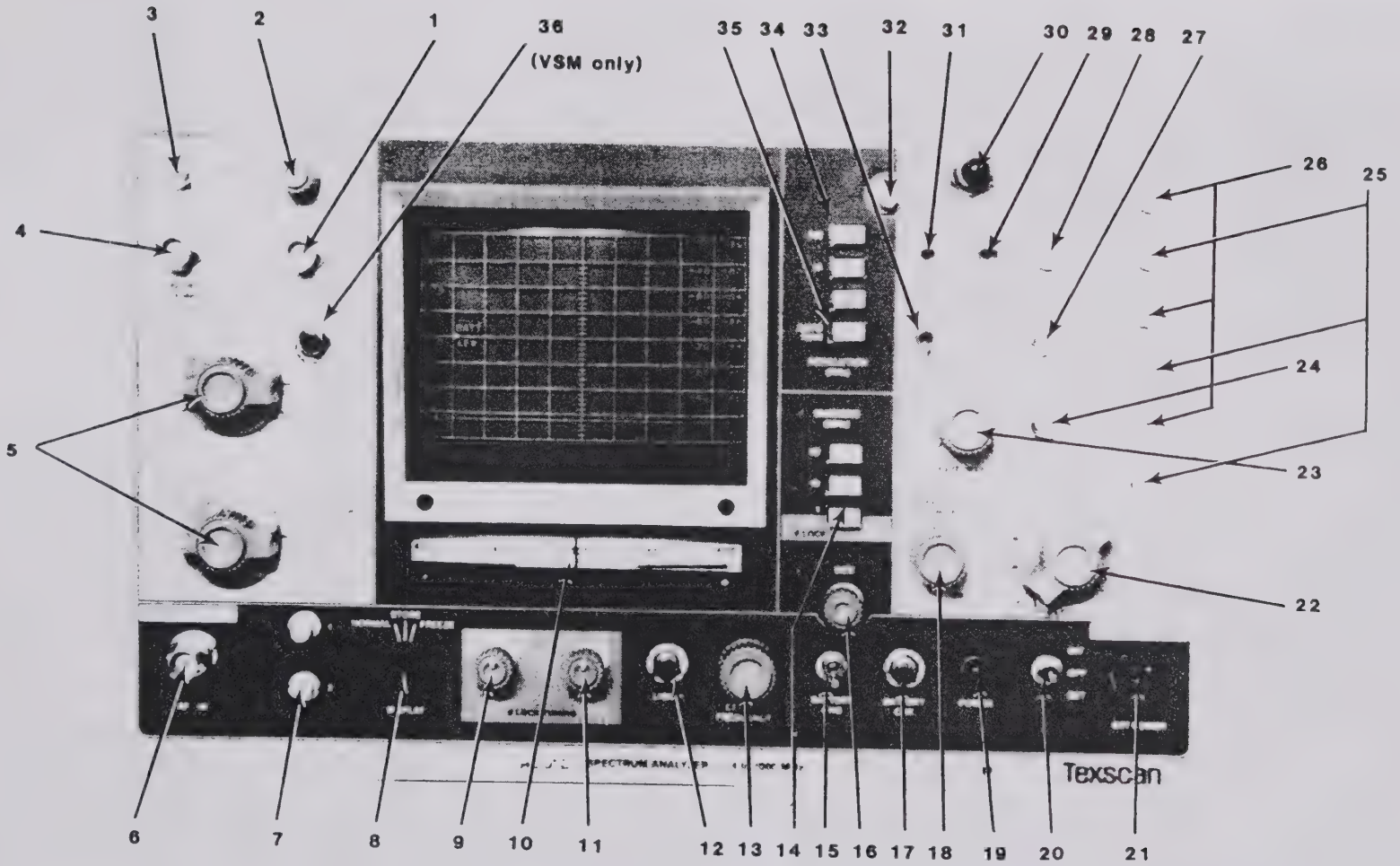


FIGURE: CONTROL LOCATIONS

WARNINGS AND NOTICES

Before you begin to operate this device, read and understand the following notices. Do this to protect both yourself and the Unit.

1. This electronic instrument was designed to be used only under the operating and storage conditions that are normally encountered by such a device. Handle and transport it with care to avoid damage to delicate components and circuits. Instruct anyone using it to avoid abusing it (throwing, dropping, striking, etc.). When you transport it in a vehicle, take care to cushion it against severe shocks that might occur.

2. The PS/C-10 power supply/charger must be set for a specific voltage (90 to 130 volts or else 180 to 270). The switch for this is located on the PS/C-10 case. **WARNING:** If your Unit (Analyzer or Power Supply) is damaged due to the application of incorrect voltage, this constitutes "misuse" and is not covered by the Warranty.

3. After the Unit has been on for a long time, the PS/C-10 may get warm. This condition is normal for this device.

4. The front panel power connection is for **+12 to 15 VDC only.** Do not connect any other power source to this connector. The vehicle power cable is for use with 12-volt negative-ground vehicles.

CONTROLS

The following paragraphs describe the location and function of the front panel controls and preliminary operating procedures. See Figure 2 or the front panel of your Analyzer for the location of the controls. The numbers following the control names correspond to the numbers on the Figure.

VIDEO OUT Connector --1
This connector provides the video information from the Wideband Detector for display on an oscilloscope or video monitor, as needed.

INT (Intensity) --2
This control adjusts the screen display's brightness.

AMPL CAL --3
With the CAL OUT (4) signal injected at the RF IN connector (6), this control is used to calibrate the graticule scale at -40 dBm and 54 MHz.

CAL OUT --4
This connector provides a 54 MHz signal with a reference level of -40 dBm. It is used in conjunction with the AMP CAL control (3) to set and check the accuracy of the Unit's calibration.

ATTN (dB) --5
The attenuators provide up to 70 dB of attenuation to the input signal.

RF IN Connector --6
This BNC connector accepts the input signal to the Analyzer.

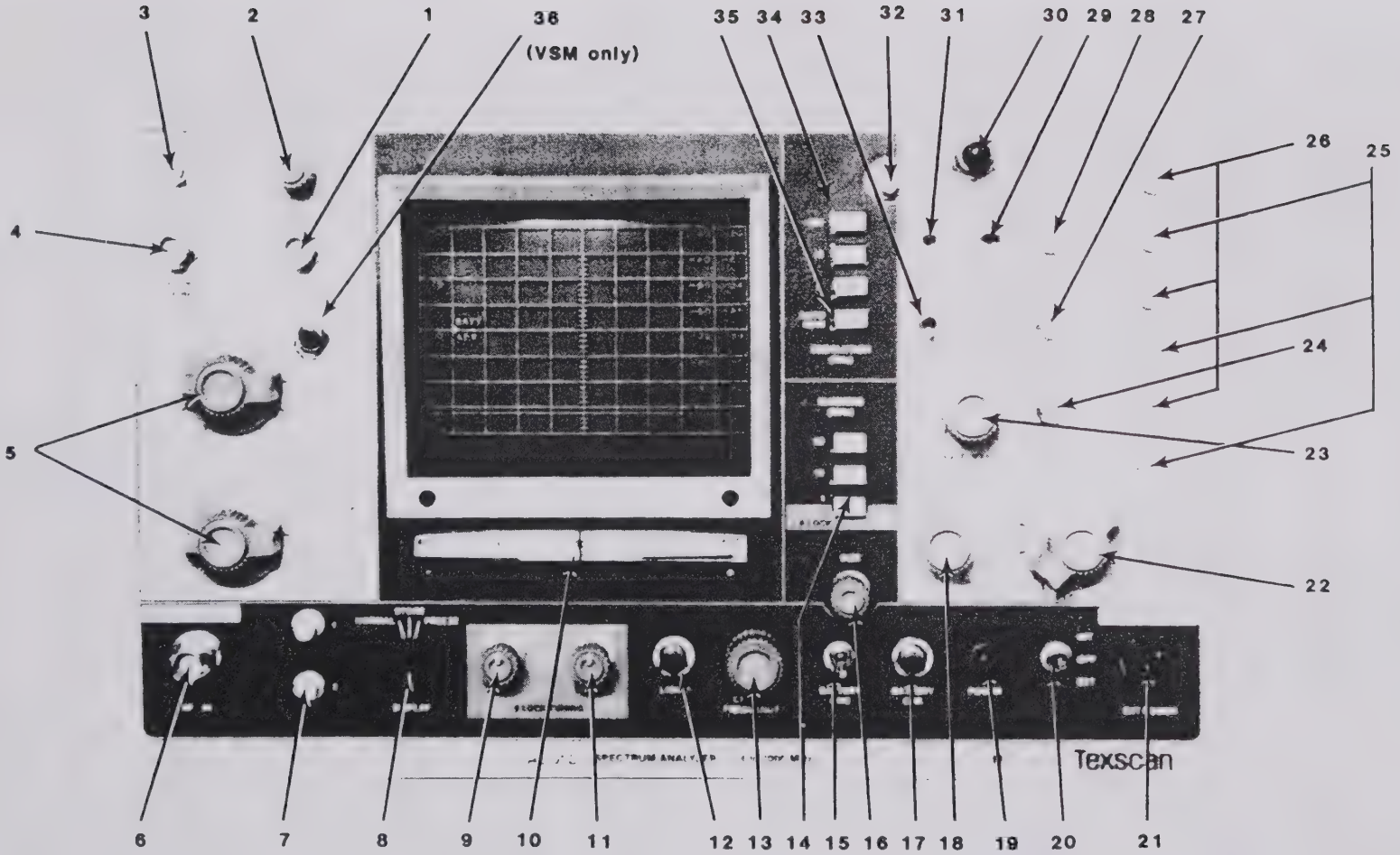


FIGURE: CONTROL LOCATIONS

TG-51 1 & 2 --7
When the Analyzer is used with a Tracking Generator, these connectors provide the output from the 1st L.O. and 2nd L.O. to the Tracking Generator.

DISPLAY --8
If you have the optional Digital Display Storage, this control will be present to control that operation.

FINE TUNE --9
This control tunes the Analyzer over a small (200 kHz) frequency range.

DIAL --10
See CENTER FREQUENCY, number 13.

COARSE TUNE --11
This control tunes the Analyzer over a larger (5 MHz) frequency range.

LIGHT Pushbutton --12
Pressing the button turns on the dial light.

CENTER FREQUENCY --13: DIAL TAPE --10
This permits continuous tuning of the Analyzer between the minimum and maximum frequency. The dial indicates the center frequency on the display.

MARKERS/PHASE LOCK --14
Pushbuttons select 1, 10, and 50 MHz markers on the CRT display. For 200 kHz/DIV dispersions or less, the phase lock switch locks the first L.O..

BATT CHG --15
This switch lets you use external power to recharge the internal battery.

SIZE --16
This control varies the amplitude of the markers on the screen.

BATT CHK --17
Pressing this button causes a vertical deflection on the display screen, to indicate the battery level. Deflection above the BATT LEV line on the screen indicates that the battery level is adequate for operation. The BATT CHG switch (15) must be in the off position for battery check.

DISPERSION VERN --18
This control allows continuous adjustment of the Analyzer's spectrum width from 1000 MHz to zero, when DISPERSION (22) is not set to the preset bands. The calibrated position is a switch detent at the full CCW end of rotation.

PWR light --19
This light will turn on whenever the Analyzer power is on.

INT-OFF-EXT --20
The switch selects the power source, or turns all power off.

+12 VDC Connector --21
This connector is for an external power source. Both a vehicle cable with cigarette lighter plug (for 12-volt negative-ground vehicles), and the PS/C-10 supply cord are provided to mate with this connector.

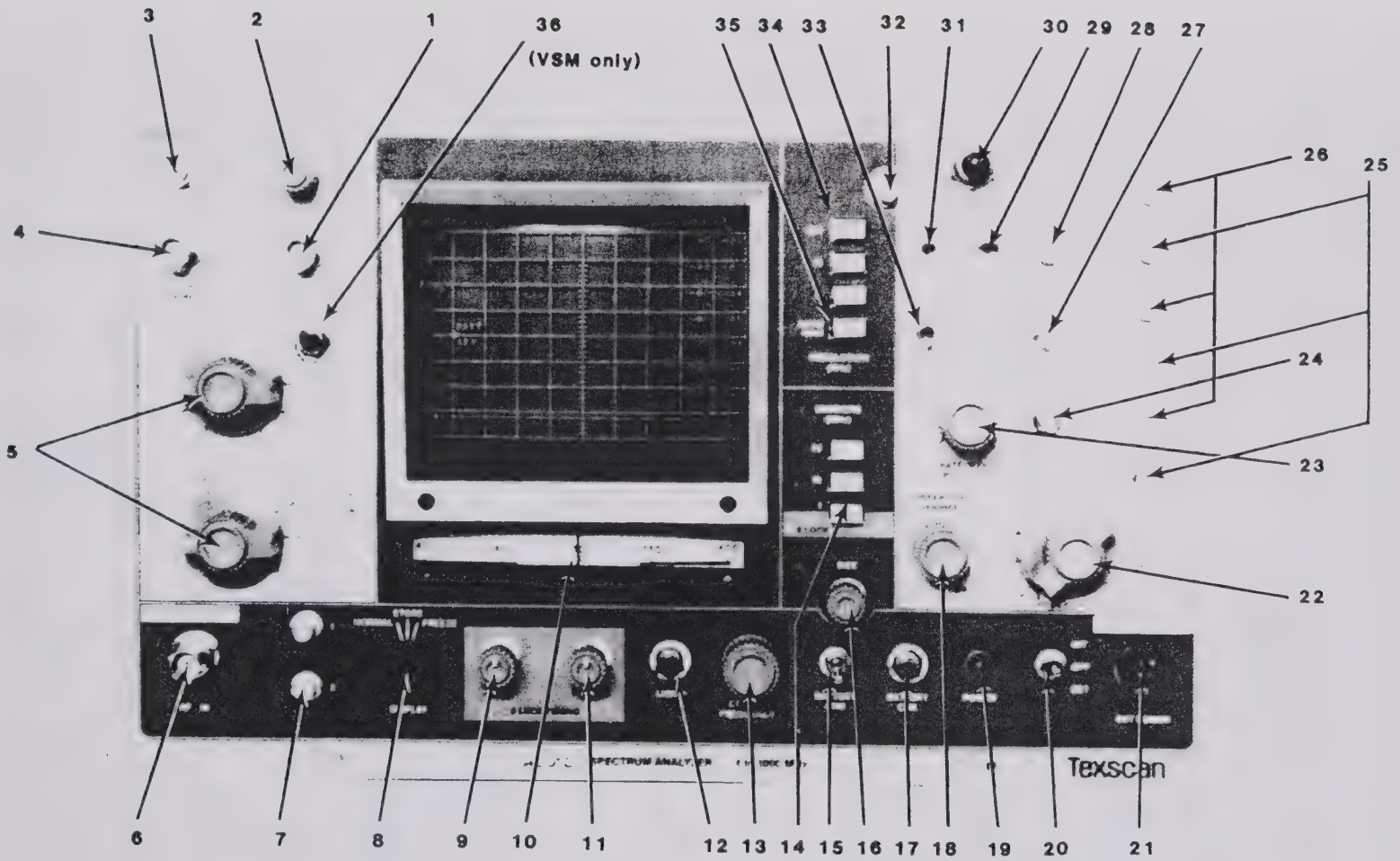


FIGURE: CONTROL LOCATIONS

DISPERSION --22
This switch selects one of the Analyzer's six dispersion widths, or the CW mode, or one of the preset bands (B, C, or D).

RATE/MAN --23
This control adjusts the variable sweep rate when the AUTO/MAN switch (35) is in the AUTO position. When the switch is in MAN, the RATE/MAN control adjusts the horizontal position of the trace. To obtain the .03 to 3 Hz rate, pull the RATE/MAN switch to the +10 position.

VERT --24
This control adjusts the vertical (up and down) position of the trace.

DISPERSION (B, C, & D) --25
Three controls permit adjustment of the dispersion width for the three presets (B, C, or D).

CENTER FREQ (B, C, &D) --26
Three controls permit adjustment of the center frequency for the three presets (B, C, or D).

HORIZ --27
This control adjusts the horizontal (sideways) placement of the trace.

DIAL CAL --28
This control is used to calibrate the dial to the display center frequency.

10 dB/DIV 2 dB/DIV Switch --29
When the LOG/LIN switch (31) is in the LOG position, this switch selects one of the two calibrated scales. The 10 dB/DIV position provides a 70 dB range, calibrated from -100 to -30 dBm. The 2 dB/DIV position provides a 12 dB range, calibrated from -92 to -80 dBm.

Interlock --30
There is a switch that interrupts the power to the Analyzer when the cover is closed; this prevents accidentally discharging the Unit by putting it away without turning it off.

LOG/LIN Switch --31
This switch selects either of two calibrated vertical display scales. In the LIN position, the left side scale on the graticule is used; in the LOG position, the right side scale is used. See also (29).

Audio Out Jack --32
The signal for the Audio board (in the cover) is supplied from this jack.

FILTER Switch --33
This switch selects reduced video filter bandwidths of 1000 Hz or 10 Hz.

RESOLUTION --34
Individual switches select the IF bandwidths (200 kHz, 10 kHz, or 0.5 kHz).

AUTO-MAN --35
This switch selects circuitry to allow control of the sweep rate (by the RATE/MAN control, #23) or provide for manual control of the sweep position.

INITIAL SETUP AND CALIBRATION CHECK

We advise that the operator become familiar with the initial setup and calibration procedure. This procedure should become a standard routine to provide improved accuracy and reliability.

1. With the INT-OFF-EXT switch in the off position, position the controls for the initial setup as follows:

INT-OFF-EXT	OFF
ATTN (dB)	0 dB
INT	MID-RANGE
10 dB/DIV-- 2 dB/DIV	10 dB/DIV
FILTER	OUT
CENTER FREQ	500 MHz on dial tape
DISPERSION	1 MHz/DIV
DISPERSION VERN	CAL (fully CW)
RATE/MAN	30 Hz (fully CW, switch pushed in)
AUTO/MAN	AUTO
RESOLUTION	200 kHz

2. Turn the Unit on and allow a few seconds to warm up.

3. Set the controls as follows:

INTensity	As needed
FILTER	1 kHz (to make it easy to see baseline)
VERT	Place baseline on CAL line
FILTER	OUT
HORIZ	Center the trace

4. Move the CENTER FREQUENCY control to place the "zero bell" at center screen.

5. Press the 50 MHz marker, center the FINE TUNE control.

6. Use the COARSE tune control to center the zero bell on the zero birdy from the 50 MHz markers.

Vertical Gain Adjustment Check

1. Connect a short 50-ohm coaxial cable between the CAL OUT connector and the RF IN connector.
2. Adjust the CENTER FREQUENCY control to display the 54 MHz -40 dB calibration signal.
3. Adjust the front panel AMP CAL (#3 on the Control figures) control to set the output to -40 dB.
4. The baseline trace should be on the graticule's CAL line. If it is not, adjust the VERT control to position the display properly.
5. Repeat steps 3 and 4 until the baseline is at CAL and the signal is at the -40 dB line.

B, C, and D Band Setup Procedure

Along with the normal DISPERSION settings on the Analyzer, these special bands were provided for use where the operator may be required to make test readings at certain frequency and bandwidth ranges throughout the test period. Bands B, C, and D can each be preset for a specific frequency and band-width to save the operator repeating the setup for each set of readings.

Note, however, that the drift rate and stability of presets are limited, due to the need to use one-turn potentiometers instead of the normal ten-turn CENTER FREQUENCY pot. The minimum bandwidth is limited to approx-imately 5 MHz and the phase lock circuitry is disabled in the B, C, and D settings.

1. Set the controls as indicated in the first step of the Initial Setup instructions.
2. Set ATTN (dB) to 40 dB.

CAUTION: Remember that the input must not exceed 1 watt, average. Further, the output of the attenuator must not exceed 0 dBm. Always insert 40 dB or more of attenuation before connecting an input. After the signal is connected, you can reduce the attenuation as needed to get adequate display.

3. Set DISPERSION to BAND B.
4. Connect the desired input and adjust the CENTER FREQUENCY for BAND B until you have the signal centered in the display.
5. Use either the 1, 10 or 50 MHz markers to aid in adjusting the BAND B DISPERSION as you desire to have it.

You now have BAND B set, and may switch to it at any desired time. Set bands C and D in the same manner, if you need to use them also.

Operation From an External +12 to 15 Volt Source

1. Connect the 12 to 15 volt, 2 amp (minimum) source to the front panel connector. Both the PS/C-10 power supply/charger and the vehicle operation cable are designed specifically for this connector.
2. Set the INT-OFF-EXT switch to the EXT position.
3. Set up and operate as usual.

Battery Charging

1. Connect the Charger/Converter and select the OFF or EXT setting for the INT-OFF-EXT switch. (You may use the Analyzer while the battery is charging.)
2. Set the BATT CHG switch to the CHG (up) position.

The battery should charge from a low of 11.5 volts to a full charge of 12.5 volts in approximately 14 hours. While the battery is charging, the Charger/Converter LED will glow with a red light; when the battery reaches full charge, the LED will change to the normal green color.

Using the Phase Lock System

Various test and measurement operations require extreme stability of the test instrument involved. Obviously, oscillator stability could not be measured if the stability of the oscillator was greater than that of the test instrument. For this reason the Analyzer has been equipped with a phase lock system to provide maximum stability (500 Hz). Follow this procedure to provide proper operation.

1. Perform the full Initial Setup operation.
2. Center the COARSE and FINE TUNE controls.
3. Adjust CENTER FREQUENCY to the approximate frequency of interest.
4. Adjust the DISPERSION control to the 200 kHz position and readjust CENTER FREQUENCY until the display is centered on the screen.

NOTE: Phase Lock functions only in the 200, 20, and 2 kHz positions of the DISPERSION control.

5. Press the PHASE LOCK button.
6. Recenter the display with the COARSE and FINE TUNE controls.
7. Adjust the RATE, DISPERSION, and RESOLUTION controls for the bandwidth of interest.

NOTE: When phase lock is employed, CENTER FREQUENCY is disabled. However, if the CENTER FREQUENCY control is moved too far, the Unit will "jump" out of lock. If you wish to adjust the display on the graticule, avoid touching the CENTER FREQUENCY control and use the FINE and COURSE tune controls instead.

AUDIO RECOVERY

The Analyzer may be used as a tunable FM or AM receiver with a 2 MHz window by performing the following steps:

1. Set DISPERSION control to 1 MHz/div and DISPERSION VERN to CAL. Tune the FREQUENCY control to the desired frequency with the aid of the tuning dial and birdy markers, if needed.
2. Switch DISPERSION to 200 kHz/div.
3. Select PHASE LOCK.
4. Set RESOLUTION to 10 kHz.
5. Set AUTO/MAN to manual.
6. Set the AM/FM and Volume (located on the fold-back cover) as needed.

If your Analyzer has Squelch, turn it off during the steps above. To use Squelch, turn the switch ON and adjust the level control as required.

APPLICATIONS

The Analyzer is a swept heterodyne receiver that displays R.F. signals in the frequency domain. Signal frequency is measured in the horizontal direction, and signal voltage in the vertical direction of the calibrated CRT display. The following paragraphs illustrate some of the applications of the Analyzer. Most of the procedures are straight-forward, and satisfactory results should be easily attained. Others may require a brief period of familiarization.

INTRODUCTION-- SCAN LOSS

NOTE: One of the most common errors in conjunction with analyzer use is in the area of amplitude measurement.

The accuracy of the amplitude measurement is dependent upon RATE timing, DISPERSION settings, and RESOLUTION settings. The interaction of these controls can contribute to "scan loss", which can give you wrong readings. You must take care therefore, to avoid "scan loss"; and provide the greatest accuracy achievable in amplitude measurements. We designed the Analyzer to provide spectrum analysis over the 4-1000 MHz range. This is a rather large bandwidth to cover at 30 Hz. With a RESOLUTION setting of 200 kHz, the response time allowed for the vertical circuitry to display the signal at full sweep width is approximately five microseconds. But the vertical amplifier cannot respond that fast, so some signal amplitude is lost, and we call that "scan loss".

You can overcome "scan loss" in the Analyzer by proper use of the variable RATE and variable DISPERSION controls. When you slow the RATE and/or narrow the DISPERSION, you increase the time available to display the vertical signal, therefore reducing "scan loss".

The general rule to follow is to reduce sweep RATE and DISPERSION width and watch the display. If the display moves up, you have eliminated some scan loss. Continue to reduce RATE and DISPERSION until you no longer see an increase in the vertical signal level displayed.

Note that when you decrease the **RESOLUTION,** the smaller bandwidth will require further reduction of RATE speed and DISPERSION width due to the reduction of bandwidth. Similarly, using the **VIDEO FILTER** requires reduction of RATE speed and DISPERSION width since the VIDEO FILTER limits the bandwidth of the VERTICAL AMPLIFIER. When you become familiar with the interaction of the RATE, DISPERSION, RESOLUTION, and VIDEO FILTER contols in terms of "scan loss," the likelihood of error in amplitude measurements will decrease.

FREQUENCY IDENTIFICATION

You can use the Analyzer and the following procedure to identify signal frequencies to within ± 100 kHz of their actual frequency.

Perform initial setup procedure in "Initial Set-up & Calibration Check" for the Analyzer, page 18.

Turn on the Analyzer and let it warm up for 10 minutes. Activate the 50 MHz markers and center the peak of the zero response about the marker using the COARSE TUNE control.

Set RESOLUTION to 10 kHz and recenter the peak of the zero response about the marker using the COARSE TUNE control.

NOTE: It may be necessary to narrow the sweep width by adjusting the DISPERSION vernier to get an accurate alignment.

CAUTION: MARKER FREQUENCY HAS NOW BEEN CALIBRATED FOR ±100 kHz ACCURACY. DO NOT READJUST THE FINE OR COARSE TUNE CONTROLS AS THIS WILL DESTROY CALIBRATION ACCURACY.

Set RESOLUTION to 200 kHz and DISPERSION to 100 MHz with DISPERSION vernier fully clockwise.

Adjust CENTER FREQUENCY to the desired signal. Then set DISPERSION to 1 MHz and recenter signal response with CENTER FREQUENCY.

Activate the 50 MHz markers. Identify the frequency of the specific 50 MHz marker by using the dial tape reading. Note whether the frequency of interest lies to the left or right of that 50 MHz marker.

Activate 10 MHz marker and count the 10 MHz markers between 50 MHz marker and the frequency of interest. If the frequency of interest is to the left, subtract 10 MHz per marker from 50 MHz marker frequency; if to the right, add to the marker frequency.

You should now have the frequency identified to within 10 MHz.

Set RESOLUTION to 10 kHz and RATE/MAN to slow rate. Activate 1 MHz markers. Adjust DISPERSION VERNIER so that 1 MHz markers are as shown in Figure 3, while keeping the frequency of interest displayed on the screen.

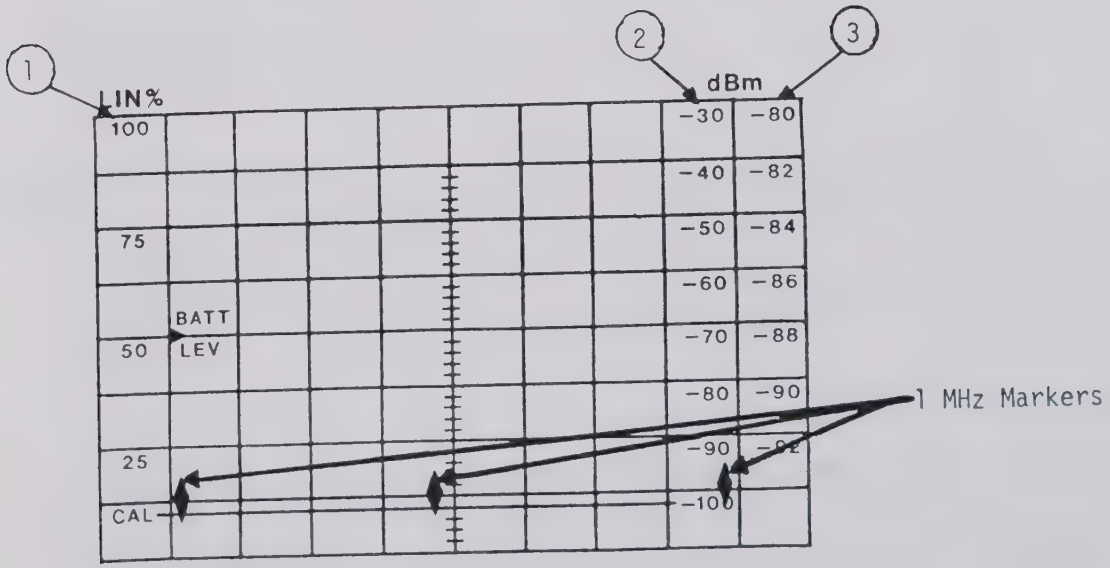


FIGURE 3

The unit is now calibrated for 200 kHz/div. By careful examination, you can evaluate any signal to within ±100 kHz of its actual frequency (100 kHz represents 1/2 of a graticule division).

AMPLITUDE MEASUREMENT

Measurement of signal levels is one of the basic functions of the Analyzer.

NOTE: Please read the note concerning amplitude measurements in the Introduction and Scan Loss section, two pages back.

Perform the Analyzer Initial Setup, page 18.

Apply the signal under test to the RF IN connector.

Set the DISPERSION control to 1 MHz/div.

Adjust the CENTER FREQUENCY control to place the signal under test in the center of the graticule.

Adjust the RATE/MAN control for a sweep rate setting as described in the section on Scan Loss (page 21).

Set the 10 dB/div--2 dB/div switch to 10 dB/div.

Adjust the RF ATTN (dB) to produce an on-screen trace with a maximum amplitude of -40 dBm as read on the graticule scale to the right of the screen.

The input voltage is the sum of the amplitude indicated on the graticule and the attenuation of the RF attenuators in dBm. Read the scale on the right side of the graticule.

NOTE: The Analyzer allows operator calibration of the vertical signal (see page 18). The accuracy of the internal calibration signal is preset at the factory to be within ± 0.25 dB at 70°F. The scale is calibrated at -40 dBm. Therefore, for greatest accuracy in amplitude measurements, if signal strength is sufficient, use the RF attenuator to decrease the displayed signal as close as possible to the -40 dBm graticule.

The Analyzer is also provided with a 12 dB LOG RANGE. This scale should be used for lower signal levels.

Adjust the RF ATTN (dB) to provide an on-screen trace with a maximum amplitude of less than -70 dBm as indicated on the graticule scale on the left of the screen.

The input voltage in dBm is the sum of the amplitude indicated on the graticule and the attenuation of the RF attenuator. Read the scale on the left side of the graticule.

SPECTRAL PURITY

Perform the initial setup procedure, page 18.

Apply the signal under test to the RF IN connector.

Adjust the RF ATTN (dB) and CENTER FREQUENCY controls to provide an on-screen trace.

Set the DISPERSION controls to give the desired sweep width.

You can now examine the signal and spurious responses. To determine the frequency and amplitude of these responses, refer to the appropriate preceding sections.

ORIENTING ANTENNAS

Perform the basic setup, page 10.

Connect the antenna downlead to the Analyzer's RF IN. If the downlead is not 50 ohms, use an impedance matching transformer.

Adjust the DISPERSION and the CENTER FREQUENCY controls to provide a display showing the signal(s) you wish to receive. Adjust the RF ATTN controls to keep the display at or below -40 dB.

Set the RATE/MAN control to a fast sweep rate and RESOLUTION to 200 kHz.

Position/rotate the antenna while watching and writing down the results. Make your decision for the antenna position based upon the results.

AMPLITUDE MODULATION

Amplitude modulation is defined as modulation in which the amplitude of a wave is the characteristic subject to variation. Side bands are produced about the carrier and the amplitude of these side bands is directly related to the level of A.M. modulation. In the log mode, this is expressed by the formula:

P side band - P carrier = 20 log M/200

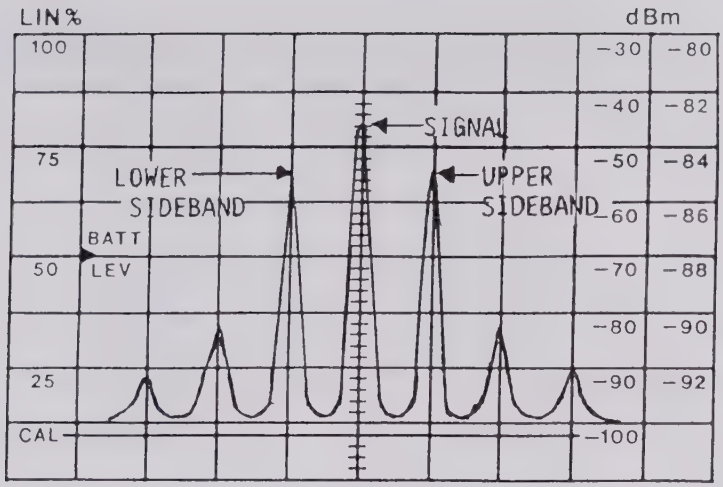
where:

M = Modulation in %

P = Power in dBm

NOTE: This procedure applies to pure sine wave modulation only

EXAMPLE: 50 MHz signal -40 dBm level, amplitude modulated by 20 kHz signal.



DISPERSION set for 20 kHz/div.

RESOLUTION set for .5 kHz.

FIGURE 4

Since the carrier and side bands differ in amplitude by approximately 12 dB, this results in a modulation level of 50%.

1. Perform the initial setup procedure, page 18.

2. Apply signal under test to the R.F. IN connector.

3. Adjust the CENTER FREQUENCY to display fundamental test signal at center graticule. Adjust DISPERSION for sweep width relating to the modulation signal. A general rule to follow would be to set the DISPERSION for a setting equal to the modulation signal frequency divided by a factor of five.

   EXAMPLE 1: 10 kHz modulation signal should be set for 2 kHz DISPERSION.

   EXAMPLE 2: 1 MHz modulation signal should be set for 200 kHz, etc.

Determine vertical amplitude of fundmental signal vs upper and lower side bands. Use formula above to determine (%) percentage of modulation.

TEST AND ALIGNMENT OF FREQUENCY CONVERTERS

A frequency converter is defined as a device that changes an alternating current from one frequency to another. Basic types of converters are mixers, multipliers, detectors, etc. The Analyzer is capable of analyzing many of the basic parameters of those types of devices.

Perform the initial setup, page 18.

Use CENTER FREQUENCY and DISPERSION to select proper frequency range.

EXAMPLE: A Double balanced mixer with LO 25 MHz at 0 dBm and mixed with 5 MHz -35 dBm results in output shown in Figure 5. The two side bands that are created (20 and 30 MHz) show a conversion loss of approximately 7 dB. The local oscillator (25 MHz) has a -60 dB isolation. The 5 MHz signal has approximately -55 dB isolation. Second order distortion products at 15-35 MHz are 48 dB down. (see Figure 6).

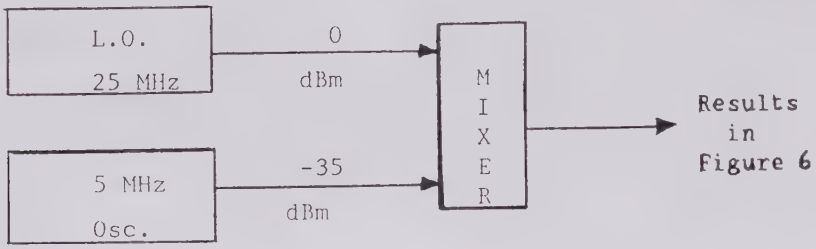


FIGURE 5

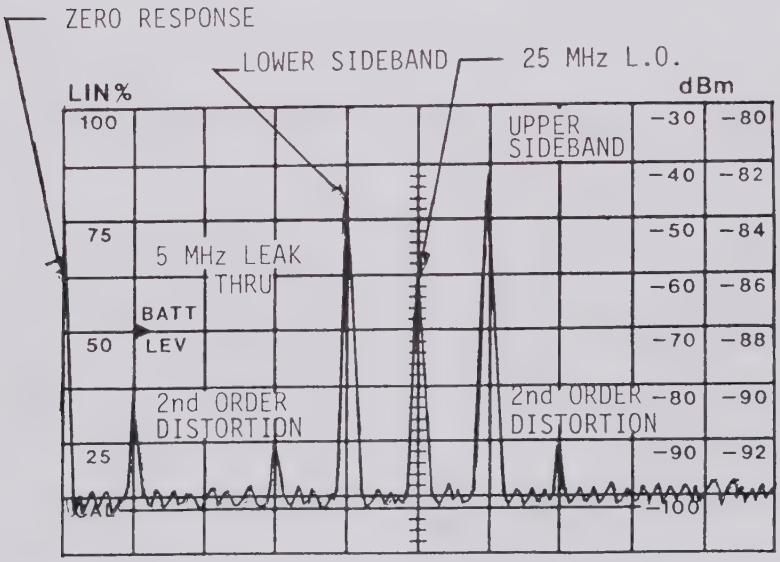


FIGURE 6

OSCILLATOR TEST AND ALIGNMENT

Since two of the basic parameters associated with oscillators are frequency and amplitude, the Analyzer is well suited for oscillator test and alignment in the 4-1000 MHz frequency range.

Perform initial control settings in page 18.

Reduce the RF ATTN until signal level is equal to or below -40 dBm.

Adjust CENTER FREQUENCY vernier until the oscillator fundamental frequency is on center graticule.

The frequency dial tape will indicate the approximate frequency. More accurate frequency identification can be made by performing the frequency identification procedure on page 21.

Oscillator amplitude can be determined by attenuating oscillator output level to a known reference level on the CRT.

EXAMPLE :	On-screen amplitude level	=	-40 dBm
	RF ATTN setting	=	30 dB
	Actual amplitude level	=	-10 dBm

Residual FM can be measured by dispersing the fundamental signal as follows.

Set the DISPERSION switch to 200 kHz position.

Center the oscillator's fundamental signal with the CENTER FREQUENCY control.

Engage the PHASE LOCK.

NOTE: The signal may offset left or right of center when phase lock is engaged. This is normal operation. Use the COARSE and FINE tune controls to move the signal to center screen.

Set DISPERSION switch to 2 kHz/div calibrated position and recenter frequency of interest if necessary with COARSE and FINE tune controls.

Slow SWEEP RATE until there is no further degradation of signal amplitude (see "Scan Loss").

EXAMPLE: Signal amplitude is -39 dBm in 2 kHz/div DISPERSION mode. Residual FM appears to be approximately 2 kHz. See Figure 7.

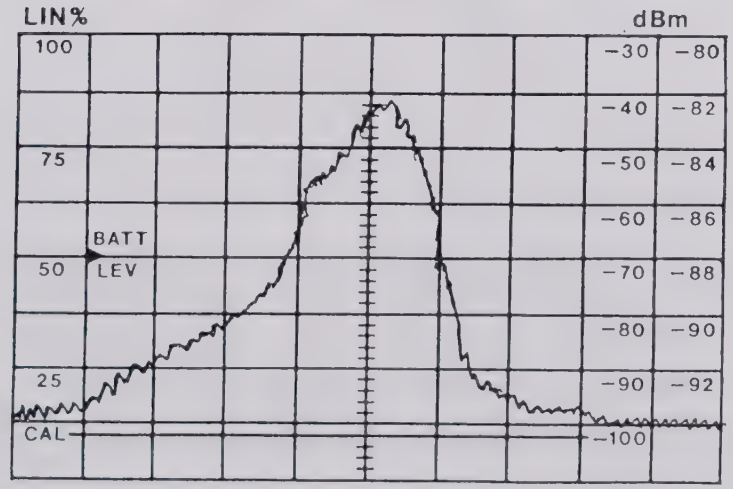


FIGURE 7

Spurious and harmonic content of the oscillator can be measured readily and accurately. (See Figure 9).

Perform setup procedure, page 18.

EXAMPLE: The fundamental frequency of oscillator is at approximately 50 MHz, -40 dBm output level.

2nd harmonic at 100 MHz, output level -72 dBm therefore, 2nd harmonic is 32 dB below the fundamental frequency.

3rd harmonic at 150 MHz, output level -90 dBm, (-50 dB) below fundamental.

4th harmonic at 200 MHz, output level -96 dBm (-56 dB) below fundamental.

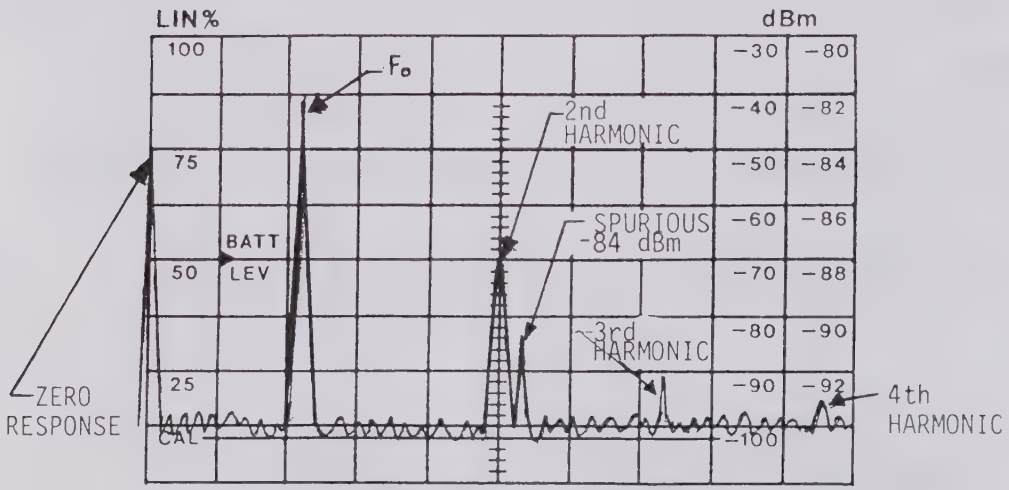


FIGURE 9

SIGNAL STRENGTH MEASUREMENTS

Perform the initial setup from page 18.

Connect an unbalanced 50-ohm dipole antenna, cut to the desired frequency, to the RF IN connector. Set the Analyzer to display the frequency being investigated (see the earlier section on Frequency Identification).

Rotate the dipole antenna to find the maximum signal strength.

The field intensity can be calculated from the following equations:

$E = (0.032\ f)\ V$

where E is the field intensity in microvolts/meter
f is the signal frequency in MHz
and V is the Analyzer reading (in volts)

We have calculated the value of the (0.032 f) from the equation, for the

different VHF television channels,and will call that "C." This changes the equation to:

$$E = C\ V$$

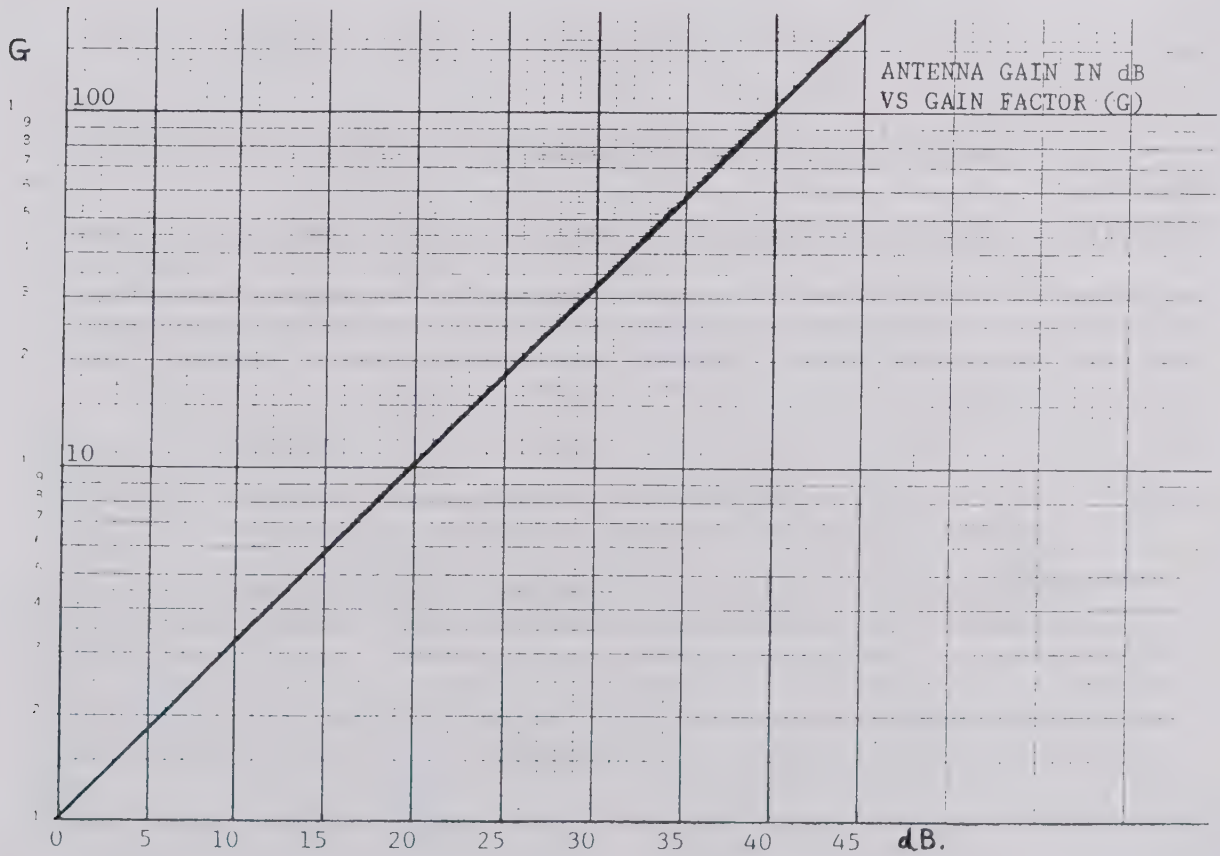
where C is shown below.

CHANNEL	"C"	CHANNEL	"C"
2	1.77	8	5.80
3	1.96	9	5.99
4	2.15	10	6.18
5	2.47	11	6.38
6	2.66	12	6.57
7	5.61	13	6.78

If the antenna is not a dipole, an antenna gain figure must be added to the formula, which becomes:

$$E = (C\ V)/G$$

Where "G" is the gain figure, found from the antenna gain in dB, by using the following graph.



CROSS MODULATION MEASUREMENT

Connect the Analyzer as indicated in Figure 10.

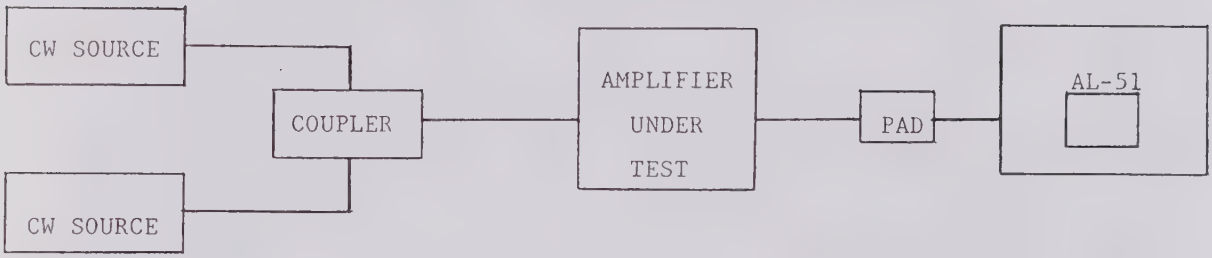


FIGURE 10

Perform the preliminary setup steps on page 18.

Adjust the FREQUENCY and DISPERSION controls to provide an on-screen display.

Adjust the RF ATTN (dB) to provide a vertical display of less than -40 dBm.

The signal observed should be a clear CW response. The presence of side-bands indicates cross modulation products. The amplitude of the cross modulation products is equal to the difference between the amplitude of the CW signal and the amplitude of the side bands.

Cross modulation (dB): = Amplitude (dBm) CW - Amplitude (dBm) Sidebands.

NOTE: Error in measurement may be introduced by impure CW sources, or cross modulation characteristics in the coupler circuitry. For precise measurements, the characteristic of the components must be taken into account.

dBm TO VOLTAGE CONVERSION AT 50 OHM

dBm	uV	dBm	uV	dBm	mV	dBm	mV	dBm	mV
-90	7.071	-70	70.71	-50	0.7071	-30	7.7071	-10	70.71
-89	7.934	-69	79.34	-49	0.7934	-29	7.934	-9	79.34
-88	8.902	-68	89.02	-48	0.8902	-28	8.902	-8	89.02
-87	9.988	-67	99.88	-47	0.9988	-27	9.988	-7	99.88
-86	11.21	-66	112.1	-46	1.121	-26	11.21	-6	112.1
-85	12.57	-65	125.7	-45	1.257	-25	12.57	-5	125.7
-84	14.11	-64	141.1	-44	1.411	-24	14.11	-4	141.1
-83	15.83	-63	158.3	-43	1.583	-23	15.83	-3	158.3
-82	17.76	-62	177.6	-42	1.776	-22	17.76	-2	177.6
-81	19.93	-61	199.3	-41	1.993	-21	19.93	-1	199.3
-80	22.36	-60	223.6	-40	2.236	-20	22.36	0	223.6
-79	25.09	-59	250.9	-39	2.509	-19	25.09	+1	250.9
-78	28.15	-58	281.5	-38	2.815	-18	28.15	+2	281.5
-77	31.59	-57	315.9	-37	3.159	-17	31.59	+3	315.9
-76	35.44	-56	354.4	-36	3.544	-16	35.44	+4	354.4
-75	39.76	-55	397.6	-35	3.976	-15	39.76	+5	397.6
-74	44.62	-54	446.2	-34	4.462	-14	44.62	+6	446.2
-73	50.06	-53	500.6	-33	5.006	-13	50.06	+7	500.6
-72	56.17	-52	561.7	-32	5.617	-12	56.17	+8	561.7
-71	63.02	-51	630.2	-31	6.302	-11	63.02	+9	630.2

APPENDIX

REMOVING THE UNIT FROM THE CASE

CAUTION

Please read the following notes before you remove your Unit from its case; You can damage the Unit while removing it from the case, or re-casing it. This damage will not be covered under your warranty.

WARNING: THE CASE FRAME AND SOME OTHER PARTS HAVE VERY SHARP EDGES. USE EXTREME CARE TO AVOID HURTING YOURSELF OR DAMAGING WIRING HARNESSES IN THE UNIT.

1. Try to determine how much case disassembly is needed during the disassembly process. In some instances with the 9552R, you may only need to remove the case cover, top, and bottom. In other instances, or with other products, you may also have to remove the entire chassis from the case frame.

NOTE: YOU SHOULD ALWAYS USE TWO PEOPLE TO REMOVE THE CHASSIS FROM THE CASE FRAME, OR RETURN IT TO THE FRAME; WHILE ONE PERSON INSTALLS THE CHASSIS, THE OTHER MUST WATCH FOR (AND PROTECT AGAINST) THE SCRAPING OR PINCHING OF WIRES AND WIRE HARNESSES.

2. Use a clean work surface, covered with a cloth, to avoid scratching the case, and proceed as follows.

Read the information on this page, then refer to the pictorial on the back of this page while you work.

3. Remove the hinge screws in the top panel, to release the case cover. Remove the top panel screws at the rear, to release the top panel.

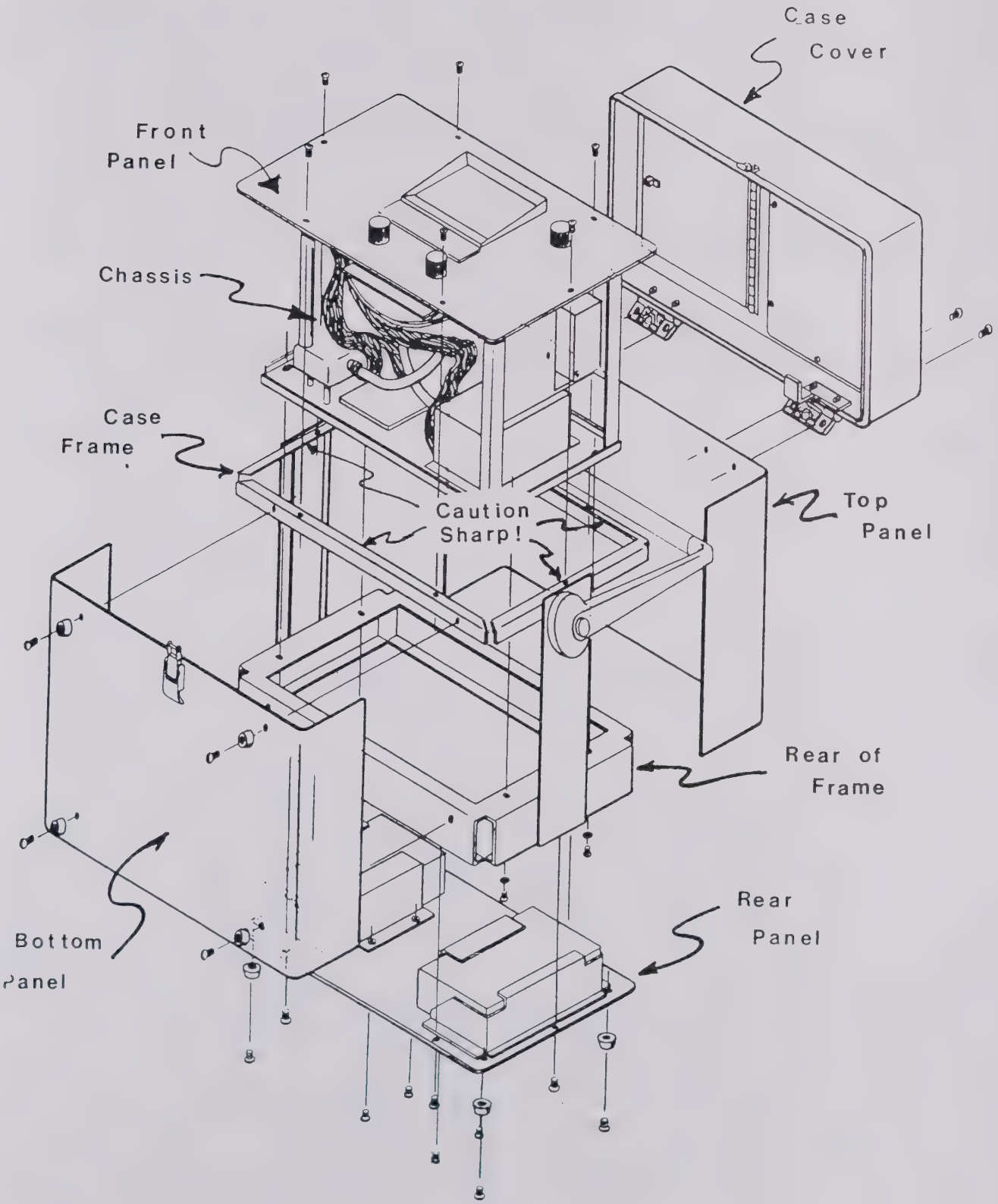
4. Remove the screws in the four feet to remove the bottom panel.

5. If it is necessary to remove the chassis from the frame, you must remove screws from: the rear panel (battery compartment-- disconnect the wires to the chassis), the rear of the frame, and the front panel.

CAREFULLY LIFT THE CHASSIS OUT THE FRONT OF THE FRAME, USING A SECOND PERSON TO WATCH AND AVOID SCRAPING OR PINCHING THE WIRE OR WIRE HARNESS.

6. When returning the chassis to the frame, reverse the above process.

IT IS EVEN MORE IMPORTANT TO PROTECT THE WIRE AND WIRING HARNESS WHEN RETURNING THE CHASSIS TO THE FRAME. YOU SHOULD USE TWO PEOPLE FOR THIS OPERATION.


Case
Cover
Front
Panel
Chassis
Case
Frame
Caution
Sharp!
Top
Panel
Rear of
Frame
Rear
Panel
Bottom
Panel

ALIGNMENT

INTRODUCTION

The Analyzer is properly aligned at the factory, and only minor adjustments should be necessary due to aging or having the unit serviced. The following describes adjustments which may be conveniently performed in the field.

---You will need the following equipment.

Voltmeter or DVM
High voltage probe (up to 5 kV) for the voltmeter
Oscilloscope (Tektronix 545 or equivalent)
Frequency counter (1000 MHz)

NOTE:See the Main PC Board Layout photograph for component locations.

Low Voltage Power Supply Adjustment

1. Apply line power and turn the Unit ON.
2. Attach the DMV between pins 3 (+) and 11 (-) of J5 (see photo).
3. Adjust R5 for +11.3 ±.1 VDC.

Rate Generator Adjustment

1. Set the Analyzer for normal operation.
2. Attach the oscilloscope between J3 pin 4 and chassis ground.
3. Set the oscilloscope to DC coupling and the 5-volt scale.
4. Adjust R101 for a triangular waveform centered around +5.7 volts.
5. Adjust R106 (the ramp amplifier pot) for a maximum 2.5 V p-p.
6. Set the RATE/MAN control on the front panel fully CW. Adjust R133 (rate time) for a one cycle span of 33 mS.

Horizontal Gain Adjustment

1. Set the Analyzer for normal operation.
2. Adjust R114 (horizontal gain pot) for a horizontal deflection of 10 cm.
3. Adjust R202 (HORIZ on the front panel) to recenter the horizontal trace on the graticule.

Vertical Gain Adjustment

1. Connect a short 50-ohm coaxial cable between the CAL OUT connector and the RF IN connector.
2. Adjust the CENTER FREQUENCY control to display the 54 MHz -40 dB calibration signal.
3. Adjust the front panel AMP CAL control to set the output to -40 dB.
4. The vertical trace should be on the graticule's CAL line. If it is not, adjust the VERT control to position the display properly.

High Voltage Power Supply Adjustment

1. Turn the Analyzer OFF.
2. Connect a high-voltage probe between the anode head (+) of the CRT and ground (-). (Observe proper cautions for high voltage operations.)
3. Turn the Analyzer back ON and allow about 15 seconds for warm up.
4. Set the front panel INTensity control to midrange.
5. Adjust R65 (High Voltage Adjust) to give a reading of 4000 volts.
6. Turn the INTensity control to maximum. If the trace "blooms," turn down R70 (Intensity Limit pot) until the bloom no longer occurs.
7. Turn the Unit OFF before you remove the high voltage probe.

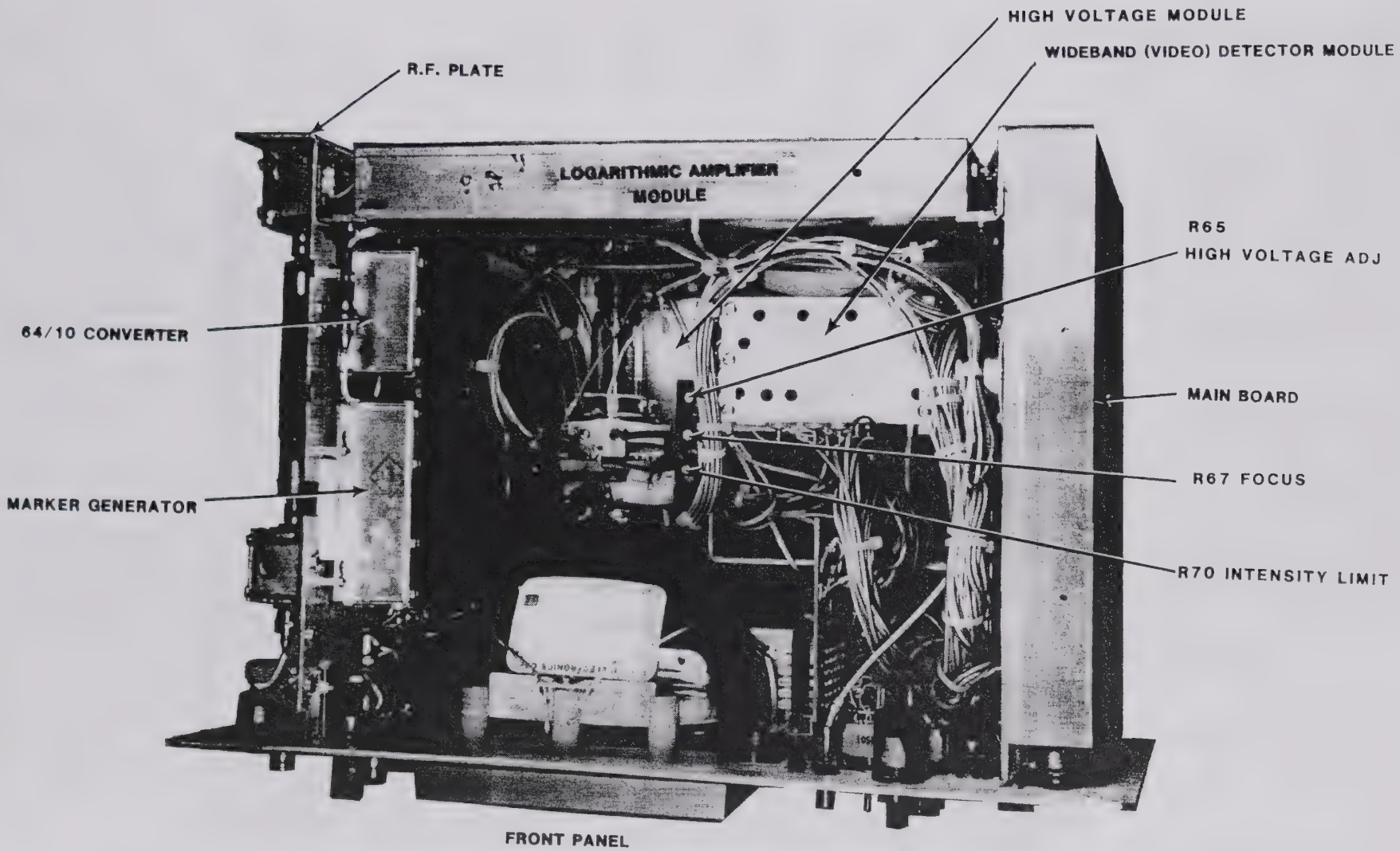
Focus Adjustment

1. Set the Analyzer for normal operation.
2. Adjust the focus using R67 (focus control).

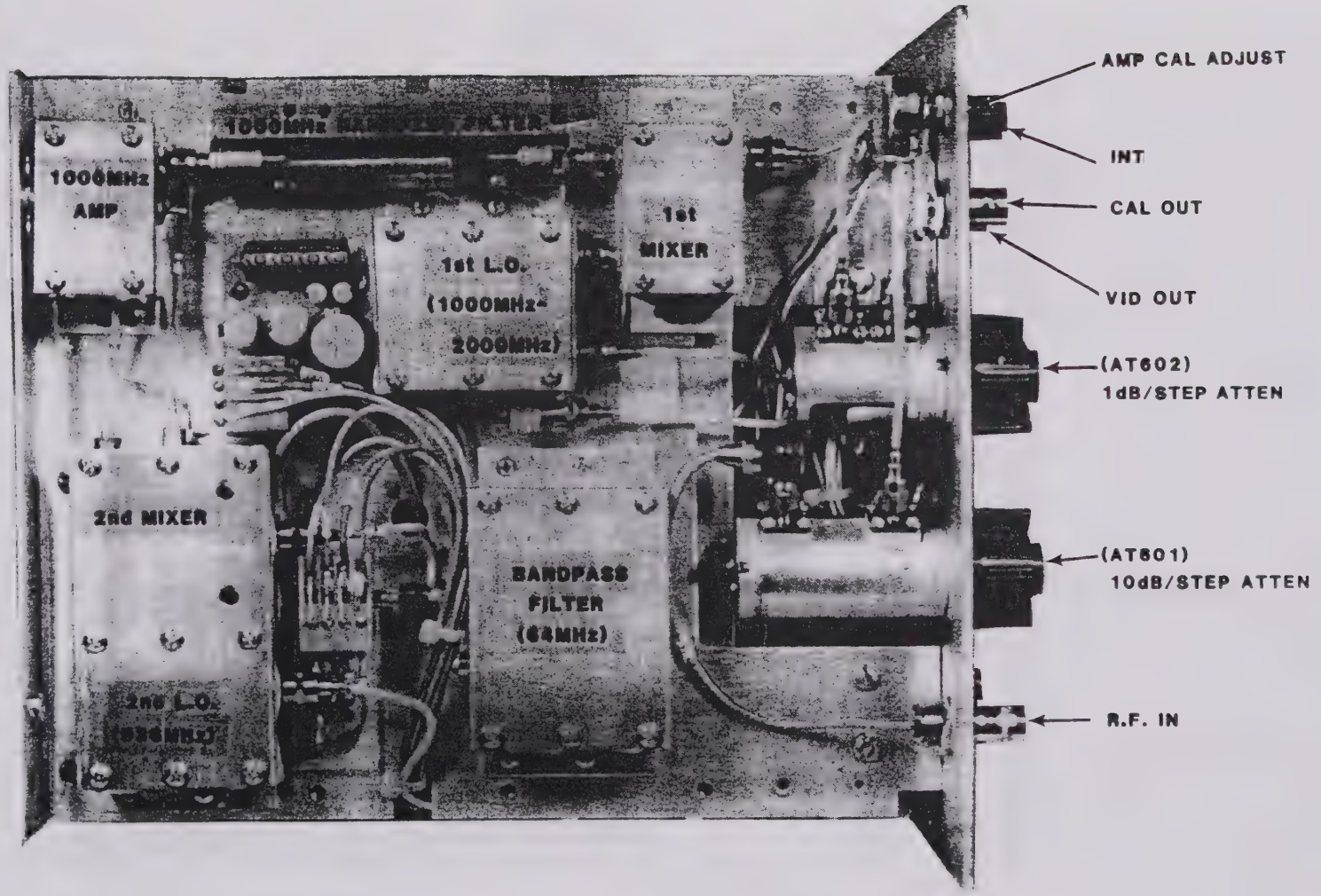
Audio Recovery Checkout

Refer to the photograph of the audio board at the end of the manual.

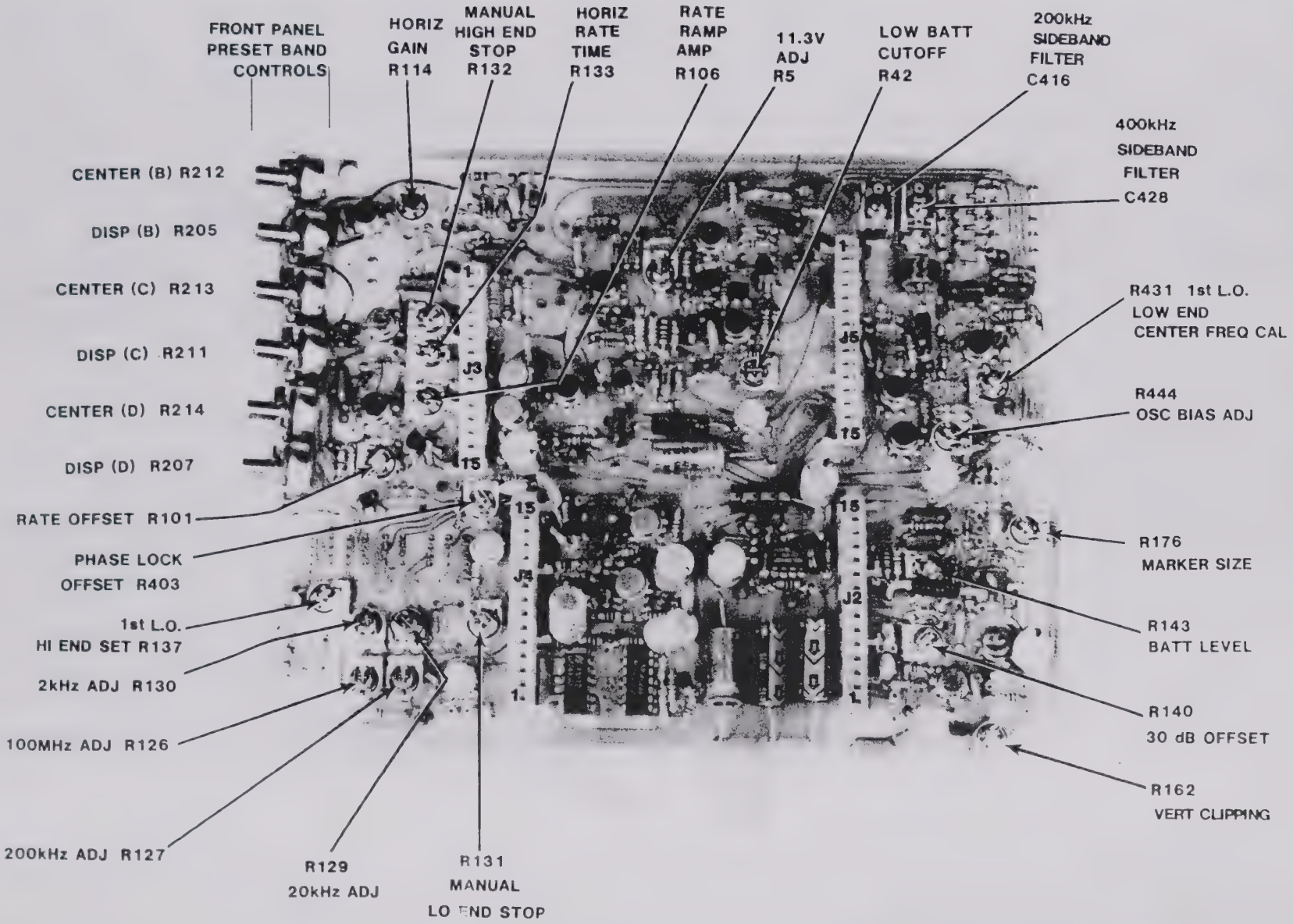
1. Check for the proper input voltage of +11.3 VDC.
2. Tune to a narrow-band FM broadcast such as NOAA (at 162.475 MHz) and set the Resolution to 10 kHz; if this signal is not available in your area, you may use any standard FM broadcast (set your Resolution to 200 kHz).
3. Set your Unit for NBFM and tune carefully to the exact center of the signal. Adjust trimmer cap C1108 for the best, clearest sound.
4. Set your Unit for AM. Stay tuned to the exact center of the signal you were using before. Adjust trimmer cap C1112 for the best, clearest sound.



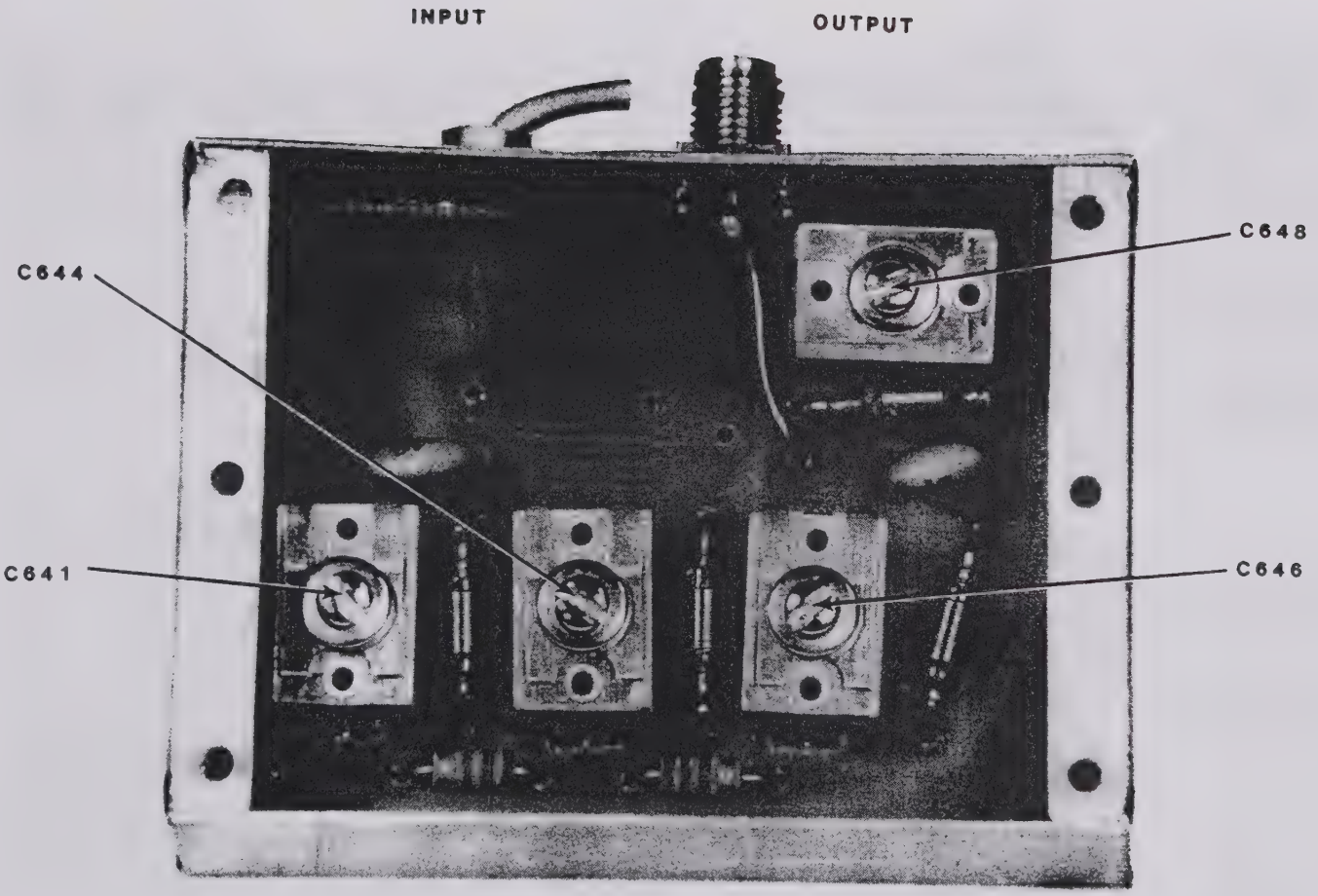
INTERIOR
(TOP VIEW)


AMP CAL ADJUST
INT
CAL OUT
VID OUT
(AT602)
1dB/STEP ATTEN
(AT601)
10dB/STEP ATTEN
R.F. IN
1000MHz
AMP
1st L.O.
(1000MHz-
2000MHz)
1st
MIXER
2nd MIXER
BANDPASS
FILTER
(64MHz)

R.F. PLATE

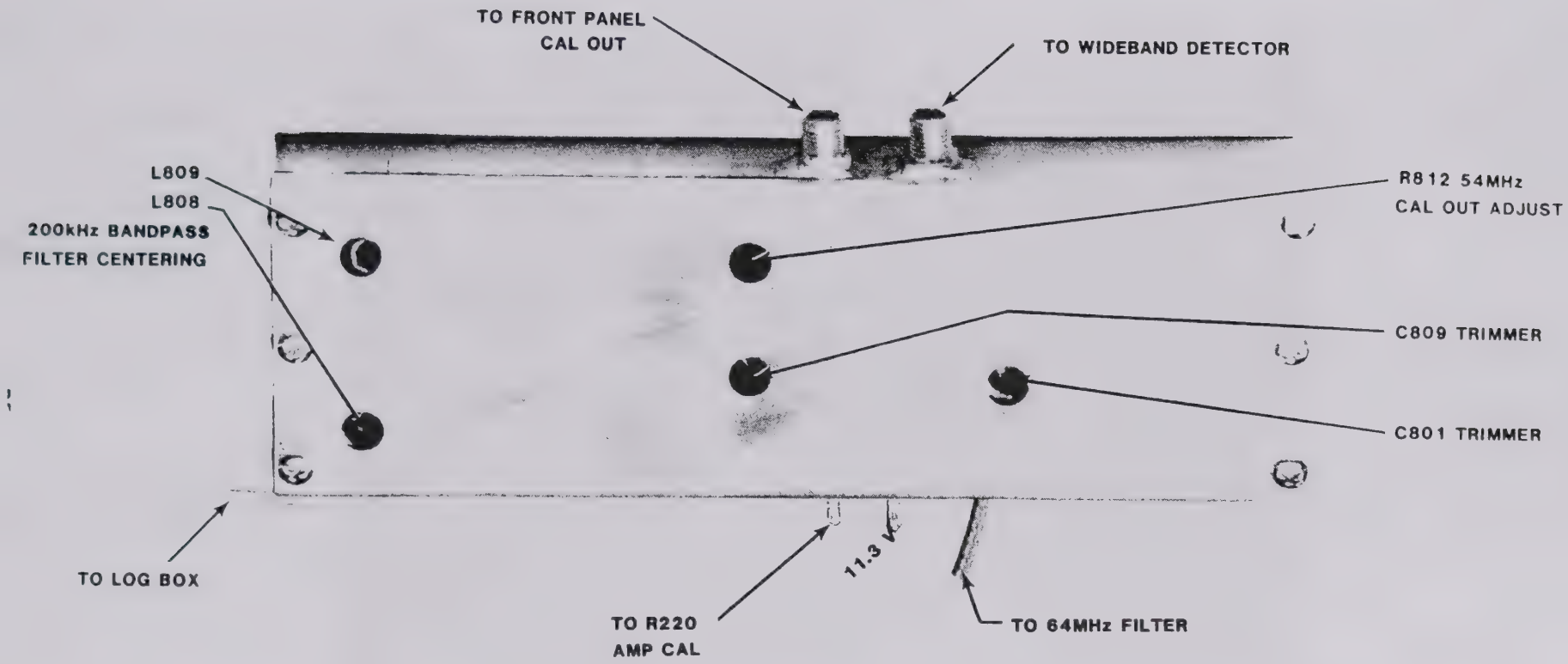

FRONT PANEL PRESET BAND CONTROLS
HORIZ GAIN R114
MANUAL HIGH END STOP R132
HORIZ RATE TIME R133
RATE RAMP AMP R106
11.3V ADJ R5
LOW BATT CUTOFF R42
200kHz SIDEBAND FILTER C416
400kHz SIDEBAND FILTER C428
CENTER (B) R212
DISP (B) R205
CENTER (C) R213
DISP (C) R211
CENTER (D) R214
DISP (D) R207
RATE OFFSET R101
PHASE LOCK OFFSET R403
1st L.O. HI END SET R137
2kHz ADJ R130
100MHz ADJ R126
200kHz ADJ R127
R129 20kHz ADJ
R131 MANUAL LO END STOP
R431 1st L.O. LOW END CENTER FREQ CAL
R444 OSC BIAS ADJ
R176 MARKER SIZE
R143 BATT LEVEL
R140 30 dB OFFSET
R162 VERT CLIPPING
J1
J2
J3
J4
J5

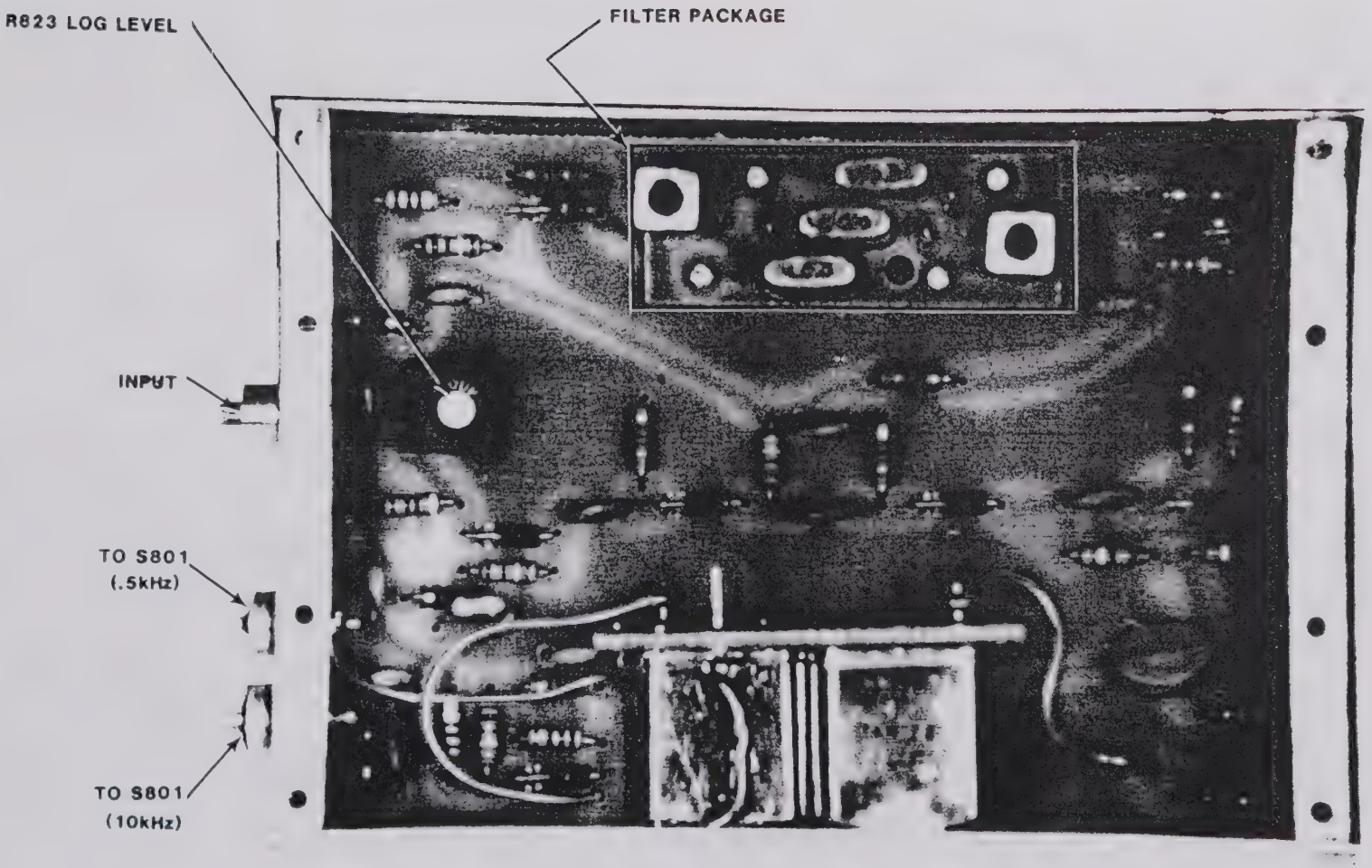
MAIN BOARD



64MHz BANDPASS FILTER

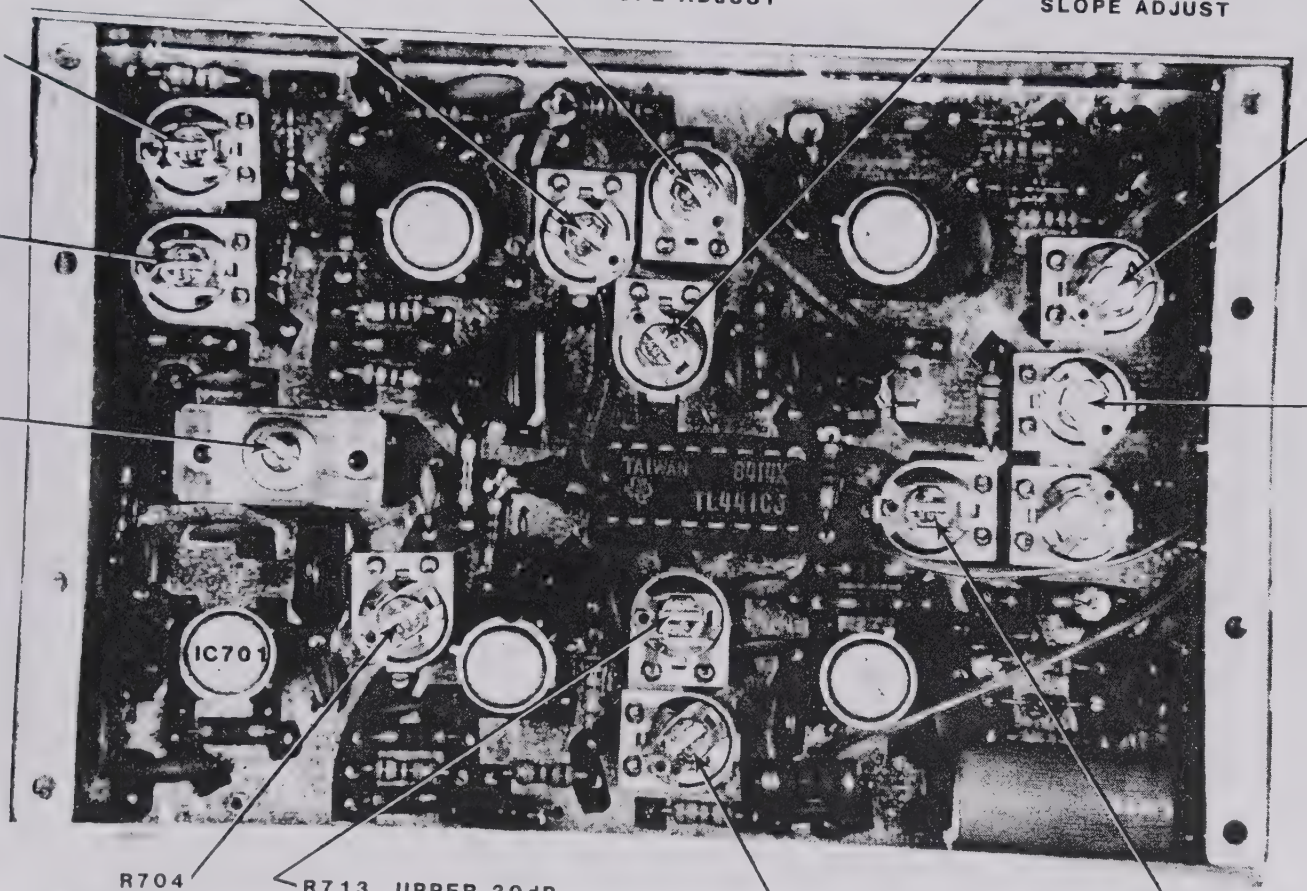
64/10 MODULE

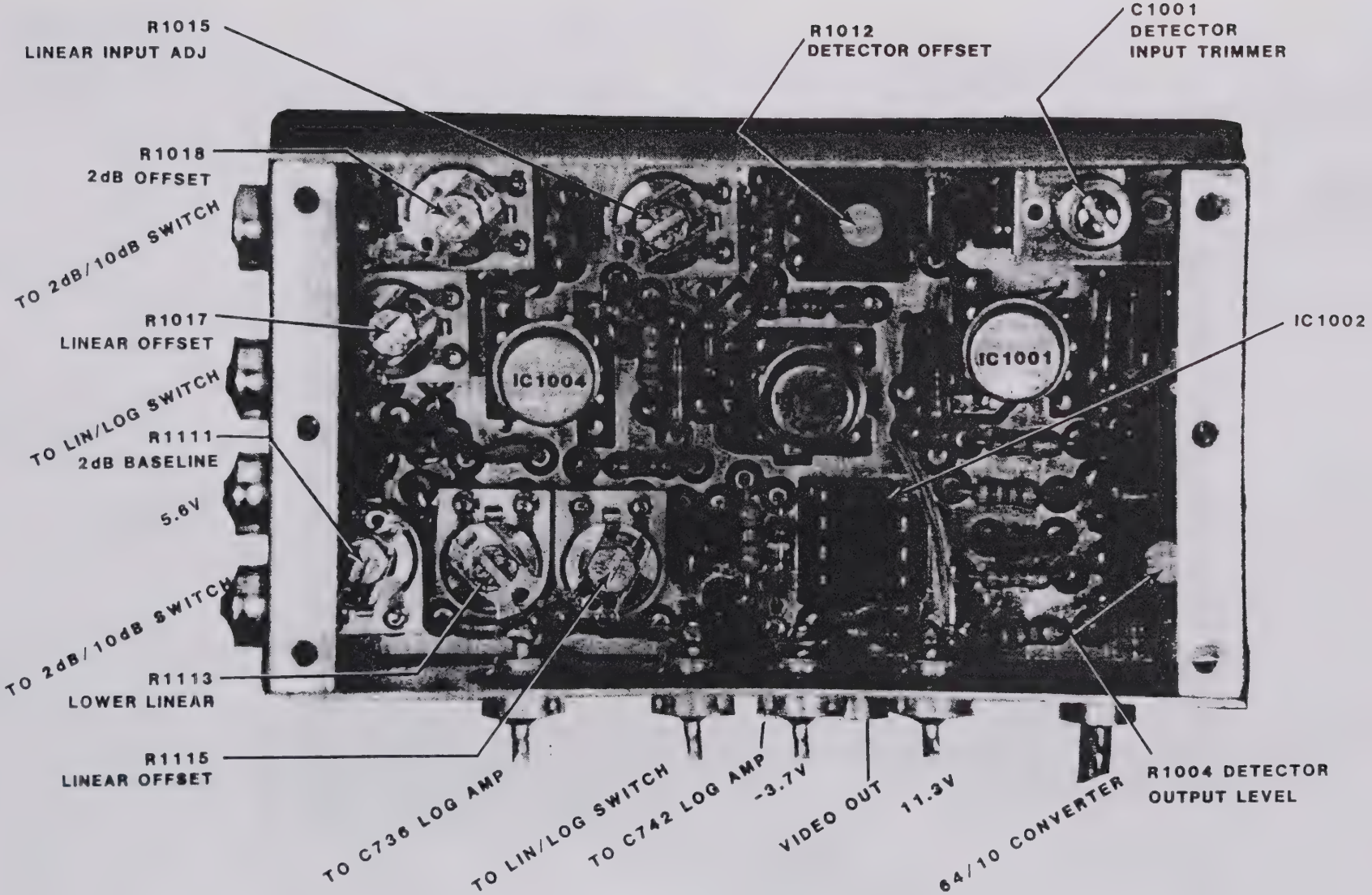

TO FRONT PANEL
CAL OUT
TO WIDEBAND DETECTOR
L809
L808
200kHz BANDPASS
FILTER CENTERING
R812 54MHz
CAL OUT ADJUST
C809 TRIMMER
C801 TRIMMER
TO LOG BOX
11.3 V
TO R220
AMP CAL
TO 64MHz FILTER



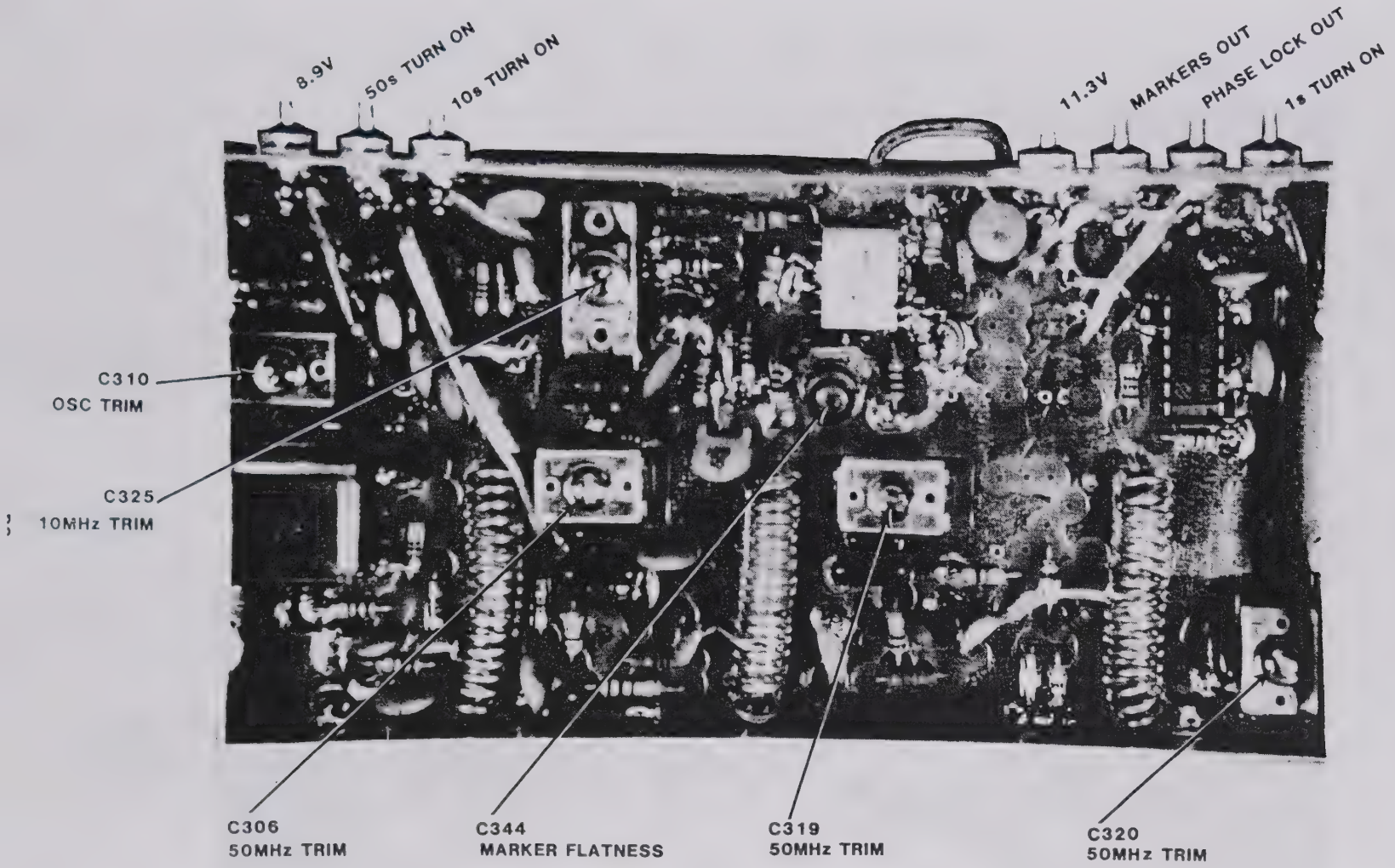
LOGARITHMIC AMPLIFIER
(LEFT PORTION OF MODULE)

LOGARITHMIC AMPLIFIER



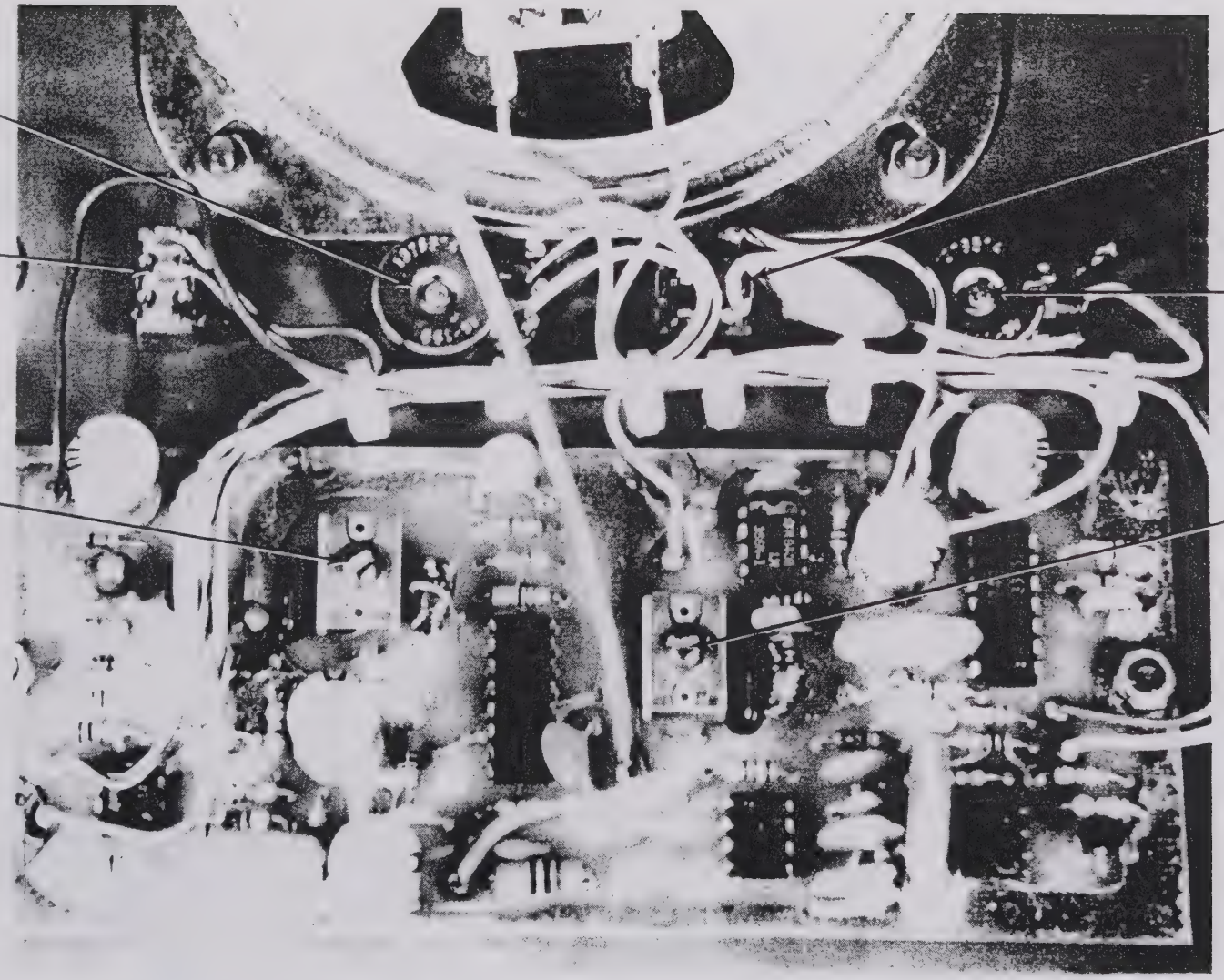


WIDEBAND DETECTOR MODULE



MARKER MODULE

(OPTIONAL) AUDIO BOARD



REPLACEABLE PARTS LIST

201-277-00	Final Assembly
205-534-00	Main Circuit board
205-512-00	First Mixer
206-079-00	High Voltage pcb
205-252-00	64 MHz TO 10 MHz Converter pcb (lg. bd.)
205-525-01	64 MHz TO 10 MHz Converter pcb (small bd.)
205-513-01	Local Oscillator Assembly
205-517-00	1000 MHz RF Amp (Z601)
205-508-01	2nd Mixer/ 936 MHz Oscillator Assy
205-522-00	64 MHz Filter Assy.
206-174-00	Audio Recovery pcb
205-537-00	Log Amp pcb
205-538-00	Crystal Filter pcb
205-526-00	Marker Generator
206-597-00	Linear & Wide Band Detector Assy
206-781-00	Resolution pcb
206-902-00	PS/C-10 power supply/charger
206-937-01	R.F.Plate
205-508-02	Hi voltage chassis 206-709-00 pcb
205-971-00	Marker sw pcb
206-781-00	Resolution/Hum pcb
206-007-00	Log Amp module-Audio
205-523-00	64 Mhz Filter pcb
205-537-00	Logamp pcb
205-538-00	X-tal filter pcb
206-902-00	PS/C-10 Power supply
206-174-00	Audio pcb

MAIN PCB 205-534-00

Ckt.Ref.No.	Description	Part No.
CAPACITORS		
C2	1000 uF, 25 V	012-404-00
C3	10 uF, 25 V, tant	012-276-00
C5	100 uF, 12 V	012-060-00
C6	.047 uF	012-267-00
C7	350 uF, 15 V	012-113-00
C8	10 uF, 25 V, tant	012-276-00
C9	1000 uF, 25 V	012-404-00
C10	.005 uF	012-085-00
C11	330 uF, 6 V	012-260-00
C28	10 uF, 25 V, tant	012-276-00
C29	68 pF	012-555-17
C30	10 uF, 25 V, tant	012-276-00
C35	10 uF, 25 V, tant	012-276-00
C36	330 uF, 6 V	012-260-00
C37	150 uF, 35 V	012-110-00
C38	.22 uF, 35 V	012-270-00
C39	.22 uF, 35 V	012-270-00
C40	1000 pF, DURA	012-138-00

C41	150 uF, 35 V	012-110-00
C42	10 uF, 25 V, tant	012-276-00
C43	47 uF, 50 V	012-220-00
C44	10 uF, 25 V, tant	012-276-00
C45	350 uF, 15 V	012-113-00
C101	FACTORY SELECTED	012-999-00
C102	1 uF, 35 V	012-291-00
C103	10 uF, 25 V, tant	012-276-00
C104	.01 uF	012-050-00
C105	.047 uF	012-267-00
C106	.047 uF	012-267-00
C107	.047 uF	012-267-00
C108	.047 uF	012-267-00
C109	100 pF	012-555-40
C110	100 pF	012-555-40
C112	2.2 uF, 35 V	012-273-00
C113	.05 uF	012-134-00
C114	.1 uF	012-269-00
C116	47 uF, 20 V	012-304-00
C117	10 pF	012-011-00
C119	.047 uF	012-267-00
C120	.047 uF	012-267-00
C121	3 pF	012-555-27
C123	100 pF	012-555-40
C124	100 pF	012-555-40
C126	470 pF	012-557-08
C127	10 uF, 25 V, tant	012-276-00
C135	82 pF	012-170-00
C136	470 pF	012-557-08
C137	470 pF	012-557-08
C138	120 pF	012-555-42
C140	82 pF	012-170-00
C214	330 uF, 6 V	012-260-00
C401	330 uF, 6 V	012-260-00
C402	.1 uF	012-269-00
C403	330 uF, 6 V	012-260-00
C404	.002 uF	012-163-00
C405	1 uF, 35 V, tant	012-291-00
C406	1 uF, 35 V, tant	012-291-00
C407	10 uF, 25 V, tant	012-276-00
C409	1 uF, 35 V, tant	012-291-00
C410	1 uF, 35 V, tant	012-291-00
C411	.01 uF	012-411-00
C412	150 uF, 15 V	012-302-00
C413	.22 uF, 35 V	012-270-00
C414	1 uF, 35 V	012-291-00
C415	.1 uF	012-269-00
C416	8-60 pF variable	015-009-00
C417	10 uF, 35 V, tant	012-276-00
C418	.1 uF	012-269-00
C419	.1 uF	012-269-00
C420	220 pF	012-557-04
C421	2.2 uF, 35 V	012-273-00
C422	2.2 uF, 35 V	012-273-00

C423	330 uF, 6 V	012-260-00
C424	10 uF, 25 V, tant	012-276-00
C425	.0047 uF	012-067-00
C427	330 uF, 6 V	012-260-00
C428	8-60 pF variable	015-009-00
C429	330 uF, 6 V	012-260-00
C430	.1 uF disc	012-268-00
C432	200 pF, DURA	012-245-00

DIODES

CR1	1N4446	025-086-00
CR2	1N4446	025-086-00
CR3	1N4446	025-086-00
CR4	1N4446	025-086-00
CR5	1N4446	025-086-00
CR13	1N752	025-050-00
CR14	1N4006	025-044-00
CR15	1N4446	025-086-00
CR16	1N4446	025-086-00
CR17	1N4446	025-086-00
CR21	1N4446	025-086-00
CR22	1N4446	025-086-00
CR24	1N4446	025-086-00
CR25	1N4446	025-086-00
CR27	1N4446	025-086-00
CR28	1N4446	025-086-00
CR102	1N4446	025-086-00
CR103	1N4446	025-086-00
CR104	1N4446	025-086-00
CR105	1N4446	025-086-00
CR106	1N4446	025-086-00
CR107	1N703A	025-003-00
CR108	1N4446	025-086-00
CR109	1N4446	025-086-00
CR110	1N4446	025-086-00
CR111	1N4446	025-086-00
CR401	1N4446	025-086-00
CR402	1N4446	025-086-00
CR403	1N4446	025-086-00
CR404	1N4446	025-086-00
CR405	1N4446	025-086-00
CR406	1N703A	025-003-00

INTEGRATED CIRCUITS

IC1	741C	076-002-00
IC2	741C	076-002-00
IC3	741C	076-002-00
IC4	741C	076-002-00
IC10	741C	076-002-00
IC11	555	076-042-00
IC101	741K	076-012-00
IC102	741K	076-012-00
IC103	741C	076-002-00
IC104	741C	076-002-00
IC106	CA3130	076-067-00

IC107	CA3130	076-067-00
IC108	CA3130	076-067-00
IC109	CA3130	076-067-00
IC401	7490	076-016-00
IC402	MC4044P	076-036-00
IC403	733	076-010-00
IC404	733	076-010-00
IC405	741K	076-012-00
IC406	741K	076-012-00
IC407	741K	076-012-00

INDUCTORS

L5	100 uH	035-041-00
L6	22 uH	035-020-00
L401	100 uH	035-041-00
L402	100 uH	035-041-00
L403	100 uH	035-041-00
L404	100 uH	035-041-00
L405	10 uH	035-007-00
L406	5 uH	035-115-00
L407	100 uH	035-041-00
L408	100 uH	035-041-00

TRANSISTORS

Q1	2N3616	062-009-00
Q2	2N3638	062-010-00
Q3	2N3568	062-015-00
Q4	2N2222	062-132-00
Q5	MJE1100	062-076-00
Q6	MJE1090	062-075-00
Q7	2N3644	062-024-00
Q8	2N3644	062-024-00
Q9	2N3568	062-015-00
Q10	2N3644	062-024-00
Q15	2N3053	062-005-00
Q16	40362	063-048-00
Q101	MJE1100	062-076-00
Q102	MJE1090	062-075-00
Q105	MJE1100	062-076-00
Q106	MJE1090	062-075-00
Q107	2N3567	062-003-00
Q108	2N3644	062-024-00
Q401	2N3565	062-002-00
Q402	2N3565	062-002-00
Q403	2N2905	062-041-00

RESISTORS

All resistors are 1/4-watt 5% unless stated otherwise.

R1	1000 ohm	045-709-00
R2	1000 ohm	045-709-00
R3	560 ohm	045-699-00
R4	2200 ohm	045-723-00
R5	2500 ohm variable	048-196-00
R6	10 k	045-751-00
R7	3920 ohm, 1%	047-445-00

R8	18.2 k, 1%	047-442-00
R9	150 k, 1%	047-447-00
R10	1 ohm, 1/2W, 10%	047-479-00
R11	1500 ohm, 1%	047-513-00
R12	1000 ohm, 1%	047-462-00
R13	1000 ohm, 1%	047-462-00
R14	3300 ohm	045-733-00
R15	3 ohm, 3W	047-075-00
R16	3300 ohm	045-733-00
R17	3 ohm, 3W	047-075-00
R40	560 ohm	045-699-00
R41	1000 ohm	045-709-00
R42	5000 ohm variable	048-209-00
R43	4700 ohm	045-737-00
R44	1500 ohm	045-716-00
R45	2200 ohm	045-723-00
R46	470 ohm	045-695-00
R47	10 k	045-751-00
R48	47 ohm, 1/2W, 10%	046-054-00
R49	10 k	045-751-00
R50	4700 ohm	045-737-00
R70	1500 ohm, 1%	047-513-00
R71	1000 ohm, 1%	047-462-00
R72	1000 ohm, 1%	047-462-00
R73	3300 ohm	045-733-00
R75	6.8 ohm, 1W, 10%	046-318-00
R76	4700 ohm	045-737-00
R77	6.8 ohm, 1W, 10%	046-318-00
R78	4.7 ohm, 1/2W, 10%	046-011-00
R79	220 ohm	045-681-00
R80	18.2 k, 1%	047-442-00
R101	50 k variable	048-197-00
R102	10 k	045-751-00
R103	1000 ohm	045-709-00
R104	20 k	045-764-00
R105	10 k, 1%	047-440-00
R106	10 k variable	048-157-00
R107	8200 ohm	045-748-00
R108	18 k	045-762-00
R110	1000 ohm, 1%	047-462-00
R111	10 k	045-751-00
R113	4700 ohm	045-737-00
R114	1000 variable	048-208-00
R115	49.9 k, 1%	047-502-00
R116	3300 ohm	045-733-00
R117	3300 ohm	045-733-00
R118	10 ohm, 1/2W	046-025-00
R119	1 ohm, 1/2W, 10%	047-479-00
R120	1 ohm, 1/2W, 10%	047-479-00
R121	10 ohm, 1/2W	045-025-00
R122	2000 ohm	047-449-00
R123	1 ohm, 1/2W, 10%	047-479-00
R124	22 k	045-765-00
R125	1000 ohm	045-709-00

R126	20 k variable	048-239-00
R127	20 k variable	048-239-00
R128	3010 ohm, 1%	047-565-00
R129	1000 variable	048-208-00
R130	200 ohm variable	048-173-00
R131	1000 variable	048-208-00
R132	20 k variable	048-239-00
R133	5000 ohm variable	048-209-00
R134	4700 ohm	045-737-00
R135	100 ohm	045-667-00
R137	20 k, variable	048-239-00
R138	1200 ohm	045-713-00
R139	3900 ohm	045-734-00
R140	500 k variable	048-241-00
R141	2700 ohm	045-727-00
R142	1000 ohm	045-709-00
R143	50 k variable	048-197-00
R144	7500 ohm	045-747-00
R145	1000 ohm	045-709-00
R146	47 ohm	045-653-00
R147	33.2 k, 1%	047-444-00
R148	1500 ohm, 1%	047-513-00
R149	150.5 ohm, 1%	047-022-00
R150	3300 ohm	045-733-00
R151	22.1 k, 1%	047-443-00
R153	47 ohm	045-653-00
R154	4700 ohm	045-737-00
R155	4700 ohm	045-737-00
R156	3 ohm, 3W	047-075-00
R157	3 ohm, 3W	047-075-00
R158	.25 ohm, 2W, 1%	047-530-00
R159	100 k, 1%	047-460-00
R160	12 k	045-755-00
R176	500 ohm variable	048-236-00
R205	10 k, variable	048-281-00
R207	10 k, variable	048-281-00
R208	5620 ohm, 1%	047-435-00
R209	542 ohm, 1%	047-333-00
R210	61.1 ohm, 1%	047-014-00
R211	10 k, variable	048-281-00
R212	10 k, variable	048-281-00
R213	10 k, variable	048-281-00
R214	10 k, variable	048-281-00
R225	2.7 ohm	045-601-00
R235	4700 ohm	045-737-00
R401	3920 ohm 1%	047-445-00
R402	1000 ohm	045-709-00
R403	2500 ohm variable	048-196-00
R404	1000 ohm, 1%	047-462-00
R405	1000 ohm	045-709-00
R406	2200 ohm	045-723-00
R407	330 ohm	045-688-00

R408	180 ohm	045-678-00
R409	1000 ohm	045-709-00
R410	1000 ohm	045-709-00
R411	820 ohm	045-706-00
R412	1000 ohm	045-709-00
R413	1000 ohm	045-709-00
R414	1000 ohm	045-709-00
R415	FACTORY SELECTED	047-999-00
R416	FACTORY SELECTED	047-999-00
R417	FACTORY SELECTED	047-999-00
R418	FACTORY SELECTED	047-999-00
R419	FACTORY SELECTED	047-999-00
R420	FACTORY SELECTED	047-999-00
R421	FACTORY SELECTED	047-999-00
R422	FACTORY SELECTED	047-999-00
R423	FACTORY SELECTED	047-999-00
R424	FACTORY SELECTED	047-999-00
R425	560 k	045-825-00
R426	120 k	045-797-00
R427	4 M	045-864-00
R428	47 k	045-779-00
R429	549 k, 1%	047-498-00
R430	15 k, 1%	047-452-00
R431	50 k variable	048-197-00
R432	150 k, 1%	048-447-00
R433	3.3 M	045-857-00
R434	100 k, 1%	047-460-00
R435	56.2 k, 1%	047-492-00
R436	68.1 k, 1%	047-446-00
R437	9090 ohm, 1/2W, 1%	047-464-00
R438	11.3 k, 1%	047-461-00
R439	15 k, 1%	047-452-00
R440	11.3 k, 1%	047-461-00
R441	11.3 k, 1%	047-461-00
R443	300 ohm, 2W, 1%	047-367-00
R444	500 ohm variable	048-236-00
R445	3300 ohm	045-733-00
R446	3300 ohm	045-733-00
R447	10 k, 10%	045-752-00
R448	15 k	045-758-00
R449	332 k, 1%	047-468-00

FIRST MIXER 205-512-00

C630	.56 pF	012-035-00
R621	330 ohm, 1/8 W, 10%	045-389-00
R622	330 ohm, 1/8 W, 10%	045-389-00
R623	15 ohm, 1/8 W, 10%	045-389-00
P604	Connector	020-331-00
J602	Connector	020-329-00
J603	Connector	020-329-00
Z601	Mixer	238-005-00

HIGH VOLTAGE PCB 206-079

CAPACITORS		
C50	150 uF, 15 V	012-302-00
C51	10 uF, 25 V	012-276-00
C52	.0015 uF	012-069-00
C53	10 uF, 25 V	012-276-00
C54	.01 uF DURA	012-066-00
C55	.01 uF	012-050-00
C56	.005 uF	012-085-00
C57	.01 uF	012-050-00
C58	1 uF, 35 V	012-291-00
C59	150 uF, 15 V	012-302-00
C60	.1 uF	012-437-00
C61	1000 pF, 9 kV	012-413-00
C62	.01 uF	012-050-00
C63	.01 uF	012-050-00
C64	.005 uF	012-085-00
C65	.005 uF	012-085-00
DIODES		
CR51	1N914	025-084-00
CR52	1N4006	025-044-00
CR53	1N914	025-084-00
CR54	1N914	025-084-00
CR55	1N914	025-084-00
CR56	1N4006	025-044-00
CR57	1N4006	025-044-00
CR58	1N4006	025-044-00
CR59	1N4006	025-044-00
INDUCTORS		
L51	100 uH, 2 amp	035-061-00
L52	100 uH, 2 amp	035-061-00
L53	100 uH	035-041-00
INTEGRATED CIRCUITS		
IC8	LM555	076-130-00
IC9	741H	076-129-00
TRANSISTORS		
Q13	2N3567	062-003-00
Q14	2N3583	062-080-00
Q15	2N3565	062-002-00
RESISTORS		
R51	24.3 k, 1%	047-675-00
R52	1000 ohm, 1%	047-462-00
R53	100 ohm	045-668-00
R54	3300 ohm	045-730-00
R55	5000 ohm, 1%	047-658-00
R56	100 ohm	045-668-00
R57	150 ohm	045-675-00
R58	5.6 ohm	045-615-00
R59	2200 ohm	045-724-00
R60	1000 ohm	045-710-00
R61	2000 ohm, 1%	047-449-00

R62	2000 ohm, 1%	047-449-00
R63	100 k	045-794-00
R64	390 M, 2W, 1%	047-567-00
R65	1 M variable	048-246-00
R66	270 k, 1/2W, 10%	046-212-00
R67	1 M variable	048-246-00
R68	10 k	045-752-00
R69	10 k	045-752-00
R70	1 M variable	048-246-00

64 MHz TO 10 MHz CONVERTER 205-525-00*

CAPACITORS

C801	8-60 pF variable	015-009-00
C802	1000 pF	012-009-00
C803	1000 pF	012-009-00
C804	1000 pF	012-009-00
C805	1000 pF	012-009-00
C806	1000 pF	012-009-00
C807	.02 uF	012-114-00
C808	1000 pF	012-009-00
C809	8-60 pF variable	015-009-00
C810	110 pF DURA	012-403-00
C811	.01 uF	012-050-00
C812	68 pF DURA	012-230-00
C813	1000 pF	012-009-00
C114	33 pF DURA	012-117-00
C815	.01 uF	012-050-00
C816	1000 pF	012-009-00
C817	1000 pF	012-009-00
C819	1000 pF	012-009-00
C821*	68 pF DURA	012-230-00
C822*	330 pF DURA	012-095-00
C823*	680 pF DURA	012-401-00
C828*	56 pF MUD	012-035-00
C829	1000 pF	012-009-00
C830*	150 pF DURA	012-297-00
C832	2.2 uF, 35 V	012-273-00

INDUCTORS

L801	.39 uH	035-045-00
L802	6.8 uH	035-010-00
L803	6.8 uH	035-010-00
L804	6-1/2 T air core	035-185-07
L805	6.8 uH	035-010-00
L806	.22 uH	035-024-00
L808*	Variable (slug # 039-005-00)	036-004-01
L809*	Variable (slug # 039-005-00)	036-004-06
L810	100 uH	035-041-00
L811	100 uH	035-041-00
L812	100 uH	035-041-00

*NOTE: Parts with an * are in different sub-assembly 205-525-01.

RESISTORS

R801	4300 ohm	045-736-00

R802	10 k	045-751-00
R803	330 ohm	045-688-00
R804	47 ohm	045-653-00
R805	100 ohm	045-667-00
R806	182 k, 1%	047-537-00
R808	47 ohm	045-653-00
R809	47 ohm	045-653-00
R810	1000 ohm, 1/2W, 10%	045-709-00
R811	47 ohm	045-653-00
R812	5000 ohm variable	048-251-00
R815	100 ohm	045-667-00
R818	240 ohm	045-684-00
R819	47 ohm	045-653-00
R828	22 ohm	045-639-00
R833	330 ohm	045-688-00
R834	3300 ohm	045-730-00
R835	3300 ohm	045-730-00
R836	680 ohm	045-702-00

MISCELLANEOUS

IC801	MC1550G integrated circuit	076-006-00
Q801	2n3564 transistor	062-001-00
Q802	S1140 transistor	062-093-00
Y801	54 MHz crystal	023-015-00
Z801	Double Balanced Mixer (SBL-1)	238-004-00

LOCAL OSCILLATOR ASSEMBLY 205-513-01

CAPACITORS

C502	3000 pF F/T	071-051-00
C503	3000 pF F/T	071-051-00
C505	3000 pF F/T	071-051-00
C506	10 uF, 25 V, tant	012-276-00
C507	6.8 uF	012-270-00
C508	6.8 uF	012-270-00
C509	.1 Uf	012-268-00
C510	47 uF, 20 V, tant	012-304-00
C512	47 uF, 25 V	012-065-00
C513	1000 uF, 25 V, electrolytic	012-548-00
C516	330 uF, 10 V, tant	012-260-00

INDUCTORS

L501	.22 uH	035-024-00
L502	.22 uH	035-024-00
L503	1 uH	035-001-00
L504	1 uH	035-001-00
L505	.39 uH	035-045-00
L506	1 uH	035-001-00
L507	1 uH	035-001-00
L508	.22 uH	035-024-00
L509	1 uH	035-001-00
L510	1 uH	035-001-00
L518	1 uH	035-001-00
L519	1 uH	035-001-00

RESISTORS

R501	33 ohm, 1/2 W	046-046-01
R502	2.7 ohm, 10%	045-602-01
R503	47 ohm, 1/8 W	045-354-01
R504	470 ohm, 1/8 W	045-396-01
R505	47 ohm	045-653-00
R506	2.7 ohm,	045-602-01
R507	2.7 ohm, 1/2 W	046-002-00
R508	470 ohm, 1/8 W	045-396-01
R509	470 ohm, 1/8 W	045-396-01
R510	470 ohm, 1/8 W	045-396-01
R511	470 ohm, 1/8 W	045-396-01
R512	22 ohm	045-639-00
R513	22 ohm	045-639-00
R514	18 ohm, 10%	045-637-01
R515	270 ohm, 1/8 W	045-386-01
R516	270 ohm, 1/8 W	045-386-01
R517	1500 ohm, 1/8 W	045-417-01
R518	1500 ohm, 1/8 W	045-417-01

MISCELLANEOUS

CV501	MDT606 varactor	064-030-00
CV502	MDT606 varactor	064-030-00
CV503	MDT606 varactor	064-030-00
CV504	MDT606 varactor	064-030-00
K501	Reed relay, 6 V, 1 A	070-009-00
Q501	NE74020 transistor	062-078-00
Q502	NE74020 transistor	062-078-00

1000 MHz RF AMP (Z601) 205-517

C600	Capacitor, .1 uF chip	012-454-00
C601	Capacitor, 1000 pF F/T	012-001-00
L600	Inductor, .39 uH	035-045-00
IC601	ATF-417	076-041-00
	Enclosure, 1000 MHz Amp	212-716-00

2ND MIXER/ 936 MHz OSCILLATOR ASSY 205-508-01

CAPACITORS

C521	220 pF	012-218-00
C522	220 pF	012-218-00
C523	.56 pF MUD	012-035-00
C524	.8-8.5 pF variable	015-013-00
C525	220 pF	012-227-00
C527	Filter Cap RFL Amp 859249-3	071-051-00
C528	Filter Cap RFL Amp 859249-3	071-051-00
C530	Filter Cap RFL Amp 859249-3	071-051-00
C531	2.2 uF, 35 V	012-273-00
C533	100 uF, 16 V	012-060-00
C602	.8-8.5 pF variable	015-013-00
C603	8-60 pF variable	015-009-00
C604	8-60 pF variable	015-009-00
C605	10 pF	012-247-00

DIODES & VARACTORS		
CR511	MV3140 Varactor	064-025-00
CR601	HP2900 Diode	025-075-00
INDUCTORS		
L511	.33 uH	035-074-00
L512	.33 uH	035-074-00
L513	.22 Uh	035-024-00
L514	FACTORY SELECTED VALUE	035-999
L515	.22 Uh	035-024-00
L601	Inductor, air core special	035-047-05
L602	.39 uH	035-045-00
L603	6.8 uH	035-010-00
TRANSISTORS		
Q503	2N5109	062-035-00
RESISTORS		
(Resistors are 1/4-watt, 5% unless marked otherwise.)		
R521	100 ohm	045-667-00
R522	100 ohm	045-667-00
R523	51 ohm, 1/2 W	046-056-00
R524	3300 ohm	045-730-00
R525	22 ohm	045-639-00
R526	498 ohm, 1%	047-503-00
R527	498 ohm, 1%	047-503-00
R528	3320 ohm, 1 W, 1%	047-359-00
R529	100 k, 1%	047-534-00
R601	47 ohm	045-653-00
64 MHz FILTER ASSY. 205-522		
CAPACITORS		
C641	4-40 pF variable	015-008-00
C642	50 pF	012-035-00
C643	.56 pF MUD	012-012-00
C644	4-40 pF variable	015-008-00
C645	.56 pF MUD	012-012-00
C646	4-40 pF variable	015-008-00
C647	50 pF	012-035-00
C648	4-40 pF variable	015-008-00
INDUCTORS		
L641	.68 uH	035-012-00
L642	.68 uH	035-012-00
L643	.68 uH	035-012-00
L644	.68 uH	035-012-00
MISCELLANEOUS		
J608	SMA Connector	020-329-00
	Enclosure	212-718-00

AUDIO RECOVERY PCB 206-174-00

CAPACITORS		
C1101	150 uF, 15 V	012-302-00
C1102	1000 pF, 500 V disc	012-009-00
C1103	1000 pF, 500 V disc	012-009-00
C1104	2200 pF	012-207-00
C1105	2200 pF	012-207-00
C1106	2200 pF	012-207-00
C1107	56 pF, 500 V, 10%	012-244-00
C1108	8-60 pF variable	015-009-00
C1109	2200 pF	012-207-00
C1110	.1 uF, 50 V disc	012-132-00
C1111	1000 pF, 500 V disc	012-009-00
C1112	8-60 pF variable	015-009-00
C1113	56 pF, 500 V, 10%	012-244-00
C1114	.02 uF, 25 V	012-309-00
C1115	.01 uF, 100 V disc	012-050-00
C1116	.05 uF, 100 V	012-134-00
C1117	.1 uF, 50 V disc	012-132-00
C1118	.1 uF, 50 V disc	012-132-00
C1119	150 uF, 15 V	012-302-00
C1120	1000 pF, 500 V disc	012-009-00
C1121	150 uF, 15 V	012-302-00
C1122	150 uF, 15 V	012-302-00
C1123	.02 uF, 25 V	012-309-00
C1124	10 uF, 25 V	012-276-00
C1125	1000 pF, 500 V disc	012-009-00
C1126	10 uF, 25 V	012-276-00
C1127	.1 uF, 50 V disc	012-132-00
C1128	150 uF, 15 V	012-302-00
C1129	1000 pF, 500 V disc	012-009-00
C1130	10 uF, 25 V	012-276-00
C1131	.01 uF, 100 V disc	012-050-00
C1132	.05 uF, 100 V	012-134-00
INDUCTORS		
T1101	28 turns	035-116-04
L1101	10 uH	035-011-00
L1102	22 uH	035-020-00
L1103	100 uH	035-041-00
L1104	14 T with tap	035-116-06
RESISTORS		
R1101	10 k	045-751-00
R1102	4700 ohm	045-737-00
R1103	330 ohm	045-688-00
R1104	4700 ohm	045-737-00
R1106	2700 ohm	045-727-00
R1107	8200 ohm	045-748-00
R1108	270 k	045-811-00
R1109	2200 ohm	045-723-00
R1110	10 k	045-751-00
R1111	4700 ohm	045-737-00
R1112	10 k	045-751-00

R1113	3300 ohm	045-730-00
R1114	33 k	045-772-00
R1115	4700 ohm	045-737-00
R1116	4700 ohm	045-737-00
R1118	5100 ohm	045-740-00
R1119	1000 ohm	045-709-00
R1120	1 M	045-835-00
R1121	15 k	045-758-00
R1122	10 k	045-751-00
R1124	5600 ohm	045-741-00
R1125	270 ohm	045-685-00
R1126	120 ohm	045-671-00
R1127	75 ohm	045-663-00
R1128	3300 ohm	045-730-00
R1129	10 ohm	045-625-00
R1130	100 k	045-793-00
R1131	470 ohm	045-695-00

INTEGRATED CIRCUITS & TRANSISTORS

IC1101	MC1349P	076-039-00
IC1102	MC1330	076-033-00
IC1103	CA3089	076-114-00
IC1104	1344P	076-100-00
IC1105	1458N	076-013-00
IC1106	LM386N	076-125-00
Q1101	2N3906	062-084-00
Q1102	2N3904	062-083-00

LOG AMP PCB 205-537-00

CAPACITORS

C702	.01 uF	012-411-00
C703	1000 pF	012-009-00
C704	.01 uF	012-050-00
C705	.01 uF	012-050-00
C706	1000 pF	012-009-00
C707	110-450 pF	015-045-00
C708	1000 pF	012-009-00
C709	1000 pF DURA	012-138-00
C710	1000 pF	012-009-00
C711	.01 uF	012-411-00
C712	.01 uF	012-411-00
C713	.01 uF	012-411-00
C714	.01 uF	012-411-00
C716	1000 pF	012-009-00
C717	1000 pF	012-009-00
C718	.1 uF	012-269-00
C719	.01 uF	012-411-00
C720	1000 pF	012-009-00
C721	1000 pF	012-009-00
C722	1000 pF	012-009-00
C723	1000 pF	012-009-00
C724	.01 uF	012-411-00
C725	.01 uF	012-411-00
C726	.01 uF	012-411-00

C727	.01 uF	012-411-00
C728	1000 pF	012-009-00
C729	1000 pF	012-009-00
C730	.01 uF	012-411-00
C731	1000 pF	012-009-00
C732	1000 pF	012-009-00
C733	.01 uF	012-411-00
C740	1000 pF	012-009-00
C741	1000 pF	012-009-00
C742	25 pF	012-008-00
C746	.01 uF	012-050-00
DIODES		
CR701	1N4446	025-086-00
CR702	1N4446	025-086-00
CR703	HP2800	025-078-00
CR704	HP2800	025-078-00
CR705	HP2800	025-078-00
CR706	HP2800	025-078-00
INDUCTORS		
L701	100 uH	035-041-00
L702	100 uH	035-041-00
L703	1 uH	035-001-00
L704	100 uH	035-041-00
L705	100 uH	035-041-00
L706	100 uH	035-041-00
L707	100 uH	035-041-00
L708	100 uH	035-041-00
L709	100 uH	035-041-00
L710	100 uH	035-041-00
L711	100 uH	035-041-00
L712	100 uH	035-041-00
L713	100 uH	035-041-00
L714	100 uH	035-041-00
L715	100 uH	035-041-00
L717	100 uH	035-041-00
L718	100 uH	035-041-00
L719	10 uH	035-011-00

RESISTORS

R701	10 k	045-751-00
R702	10 k variable	048-331-07
R703	10 k variable	048-331-07
R704	200 ohm variable	048-331-02
R705	51 ohm	045-656-00
R706	51 ohm	045-656-00
R708	51 ohm	045-656-00
R709	51 ohm	045-656-00
R710	1000 ohm 1%	047-462-00
R711	200 ohm variable	048-331-02
R712	10 k variable	048-331-07
R713	10 k variable	048-331-07
R714	10 k variable	048-331-07
R715	10 k variable	048-331-07
R716	1000 ohm	045-709-00
R717	1000 ohm	045-709-00
R718	10 k	045-751-00
R719	10 k variable	048-331-07
R720	1000 ohm	045-709-00
R721	1000 ohm	045-709-00
R722	10 k	045-751-00
R723	10 k variable	048-331-07
R724	10 k variable	048-331-07
R725	10 k variable	048-331-07
R727	10 k	045-751-00
R730	1000 ohm	045-709-00
R731	1000 ohm	045-709-00

TRANSISTORS & INTEGRATED CIRCUITS

IC701	1550G	076-006-00
IC702	MC1733GG	076-010-01
IC703	MC1733GG	076-010-01
IC704	TL441CN	
IC705	MC1733GG	076-010-01
IC706	MC1733GG	076-010-01
Q701	2N3564	062-001-00
Q702	2N3564	062-001-00

CRYSTAL FILTER PCB 205-538-00

CAPACITORS

C839	1000 pF	012-009-00
C841	1000 pF	012-009-00
C843	1000 pF	012-009-00
C844	1000 pF	012-009-00
C845	.01 uF	012-050-00
C846	.01 uF	012-050-00
C847	.01 uF	012-050-00
C848	.01 uF	012-050-00
C849	1000 pF	012-009-00
C855	.05 uF	012-134-00
C858	1000 pF	012-009-00
C860	.1 uF	012-268-00
C861	1000 pF	012-009-00

C863	.01 uF	012-050-00
C864	1000 pF	012-009-00
C865	1000 pF	012-009-00
C866	1000 pF	012-009-00
DIODES		
CR801*	1N277	025-012-00
CR802*	1N277	025-012-00
CR803*	1N277	025-012-00
CR804*	1N277	025-012-00
CR805*	1N277	025-012-00
CR806*	1N277	025-012-00
CR807*	1N277	025-012-00
CR808*	1N277	025-012-00
INDUCTORS		
L827	100 uH	035-041-00
L828	100 uH	035-041-00
L829	100 uH	035-041-00
L830	100 uH	035-041-00
L831	100 uH	035-041-00
L832	100 uH	035-041-00
L833	100 uH	035-041-00
L834	100 uH	035-041-00
L835	100 uH	035-041-00
L836	100 uH	035-041-00
L838	100 uH	035-041-00
L839	100 uH	035-041-00
RESISTORS		
R816	3900 ohm	045-735-00
R817	150 ohm, 10 %	045-675-00
R820	3900 ohm	045-735-00
R821	470 ohm	045-695-00
R822	3900 ohm	045-735-00
R823	1000 ohm variable	048-250-00
R827	1000 ohm	045-709-00
R828	150 ohm, 10 %	045-675-00
R829	3900 ohm	045-735-00
R830	3900 ohm	045-735-00
R831	1000 ohm	045-709-00
R833	3900 ohm	045-735-00
R834	3900 ohm	045-735-00
R835	3900 ohm	045-735-00
OTHER		
Z802*	10 MHz crystal filter assy	071-055-01
Z803*	.5 MHz crystal filter assy	071-018-00

Parts marked with an asterisk (*) are not included as part of assembly 205-538.

MARKER GENERATOR 205-526

C304	1000 pF F/T capacitor	012-001-00
C305	1000 pF F/T capacitor	012-001-00
C315	1000 pF F/T capacitor	012-001-00
C334	1000 pF F/T capacitor	012-001-00
C348	1000 pF F/T capacitor	012-001-00
C349	10 pF F/T capacitor	012-141-00
C350	.1 uF capacitor	012-132-00
C352	1 uF, 35 V capacitor	012-291-00
C355	10 pF F/T capacitor	012-141-00
	Enclosure	212-713-00

RESOLUTION PCB ASSY 206-781-00

C202	.05 uF, 100 V, capacitor	012-134-00
C203	.0022 uF capacitor	012-144-00
CR208	1N4446 diode	025-086-00
R235	4700 ohm resistor	045-737-00
R254	FACTORY SELECTED VALUE	045-999-00

OTHER ITEMS

AT601	Attenuator, 10 dB steps	200-934-02
AT602	Attenuator, 1 dB steps	200-995-03
	CRT Yoke	204-894-05
	AC line cord for PS/C-10	206-960-01
	LED, red & green, for PS/C-10	025-152-00
	Batteries (2 per unit)	009-012-00
	Top Cover	211-588-00
	Bottom Cover	206-862-00
	Lid	206-865-00

OPERATING AND INSTRUCTION MANUAL

DIGITAL STORAGE OPTION

MODEL DS-9

P/N 001-025

1. DESCRIPTION

The DS-9 Digital Storage Option is built into a spectrum analyzer, such as the VSM-2, VSM-5, AL-51, or AL-55. It allows you to store any single sweep shown on the analyzer's screen in digital memory. The display area is broken down into a grid that has 1024 points horizontally and 256 points vertically. The stored sweep is then reconstructed on the screen, by drawing a line from each point to the next. While the original sweep display may be at a slow, flickering sweep speed, the reconstructed display is generated at a faster, easier-to-see, 15 Hz.

The DS-9 is typically used in the STORE (dynamic) mode to store and display a slow speed sweep, minimizing the flicker, while updating it as each new sweep moves across the screen. In the FREEZE mode, a single sweep is stored and retained, without being updated.

The primary circuit elements of the DS-9 are analog-to-digital conversion, MOS memory, and digital-to-analog reconversion for the display.

2. INSTALLATION

The DS-9 is shipped as an integral part of the spectrum analyzer. Observe the unpacking and shipping instructions for the analyzer.

3. OPERATING INSTRUCTIONS

General:

The DS-9 uses power from the analyzer's charger/converter. Because of this additional 250 ma load, the charger/converter will run hotter than normally expected.

Noise:

Noise can be a problem in both storage and non-storage applications, because the noise level can raise the baseline until it interferes with the signal you are trying to view. You can reduce noise problems with certain control settings on your analyzer. Do the following to help improve resistance to noise.

1. Reduce the resolution bandwidth (RESOLUTION).
2. Reduce the video filter width (FILTER, or VIDEO FILTER).
3. Reduce the sweep rate (RATE/MAN).

Frequency markers will appear as bursts of noise if you leave the markers on the screen while operating in the storage mode. This is because the timing for the markers is not synchronized with the storage sweep ramp. Turn the markers off while using the storage function.

Front Panel Controls:

DISPLAY: This switch selects the NORMAL, STORE or FREEZE position.

In the NORMAL position, there is no power to the digital storage circuitry and the spectrum analyzer operates normally, in real time.

With the switch in the STORE position, the storage function is on; the analyzer display now shows the stored, digitized data. This display is updated at the rate selected by the RATE/MAN control (from 2 to 7.5 seconds per update).

With the switch in; the FREEZE position, the analyzer displays the information currently in memory, without changing or updating this information.

RATE/MAN: When the DISPLAY switch is in the NORMAL position, the control acts just as it should for the analyzer. When the DISPLAY switch is in the STORE position, this control sets the rate at which the information is sampled and fed to the DS-9's memory. The rate is adjustable between 2 and 7.5 seconds per complete update. This shows up on the display as a "sweep" moving across the display screen, updating the display.

4. CIRCUIT DESCRIPTION

Introduction:

The DS-9 consists of a peak detector with sample and hold, an analog-to-digital converter, an 8 X 1024 bit static RAM, three digital-to-analog converters, three clocks (for write, timing, and display) and the required timing circuitry. Signals and power to and from the spectrum analyzer are routed through the display switch.

In the NORMAL position of the display switch, the DS-9 is inactive.

In the STORE position of the display switch, data from the spectrum analyzer is stored (at the input sweep rate) and displayed at a constant rate.

In the FREEZE position, the input to the memory is disabled and the current contents of the memory are read and re-read at a constant rate. In this condition, the memory can be read for an indefinite period of time. However, two things can cause this information to be lost from memory. If the power is turned off, the information in memory will be lost; if the DISPLAY switch is changed to STORE the contents of memory will be updated, erasing the current contents.

Peak Detector, Sample And Hold: (IC19, 26, 43)

The maximum amplitude of the vertical input during a convert cycle is detected by the peak detector. This amplitude is stored by the sample-and-hold-for-readout during the next convert cycle. The peak detector capacitor is discharged through Q1208 during the start-convert period. The sample one shot from IC21B enables the input to sample-and-hold capacitor C1233. The start-convert one shot (second half of IC42, pin 11) is triggered by the trailing edge of the sample one shot pulse (first half of IC42, pin 6).

Analog-To-Digital Converter: (IC26)

The vertical output from the sample-and-hold is buffered at IC20B and offset at IC18C before being applied to the analog-to-digital converter. The reason for the buffer is to extend the maximum amplitude signal over the entire range of memory. The vertical signal to the analog-to-digital converter is converted to an eight-bit digital word by the converter. The conversion clock is generated by timing clock IC16, and logic generator IC14 and its associated circuitry. The eight bit output of the converter is coupled to three-state buffers IC29 and IC28, to be stored in memory.

Three-State Buffers: (IC28, 29, and 41)

The three-state buffers serve the eight-bit data lines from A-to-D converter IC26 and also the address lines from the write and display circuitry (IC's 1, 2, 3, and 4). The eight data lines from IC26 provide the vertical information, while the ten address lines provide the horizontal position (which is also the storage address in memory). The buffers convert the CMOS output level of the analog-to-digital converter to the TTL-compatible level required by the memory. The buffers also isolate the outputs of the analog-to-digital converter from the memory data bus.

Memory: (IC30 & 31)

The 1024 X 8 bit memory is composed of two 1024 X 4 bit CMOS static RAM integrated circuits, and will maintain the stored information as long as power is supplied to the circuits. The memory will accept data from IC26 when the read/write line (pin 10) is low, and will store that data in the memory address dictated by the write circuitry (IC5 through IC1 and 2, and IC28 and 41) on the address lines.

At another time the memory can output the pieces of vertical information to the data latches (IC36 and 37) for display on the screen. The display address (from IC6 through IC3 and 4, and IC28 and 41) selects the right address for the bits of vertical data and the read/write line (from Q1206) selects the "read" operation, while the enable line (from Q1207) tells the memory exactly when to perform the read or write operation.

Data Latches: (IC36 & 37)

Data on the eight-bit data bus is latched into two quad-D flip-flops. The latch timing is controlled by the de-glitch circuitry (IC17C & D) and the display clock at IC17B. The latching action is delayed slightly to avoid noise at the data pulse edges.

Vertical Digital-To-Analog Converter: (IC38)

The output of the data latches is converted to an analog signal by the vertical digital-to-analog converter. The timing of the vertical output is synchronized to the display clock through Q1207 and IC17B.

Low-Pass Filter Amplifier: (IC40B & C)

The output of vertical D-to-A converter IC38 is coupled to low-pass filter amplifier IC40C pin 9. The filter integrates the data input to produce line segments on the screen. The connected line segments make the display smoother and easier to read.

OUTPUT SIGNAL CONDITIONING AMPLIFIER: (IC40A)

The output signal conditioning amplifier provides gain and offset control of the vertical signal. The signal conditioning matches the vertical output characteristics of the DS-9 to the input characteristics of the spectrum analyzer.

Write Clock: (Q1201 & Q1202)

The write clock is a unijunction transistor (Q1201) oscillator with a transistor amplifier (Q1202). Clock timing is determined by the setting of the RATE/MAN control on the front panel. The write cycle address (position in the write cycle) can be seen moving across the display if you change the setting of the video filter switch; this changes the base line position of the trace slightly at the current point in the write cycle.

Write Binary Counter: (IC5)

The write binary counter converts the write-clock input to a ten-bit binary address. This binary address is used during the memory write cycle and represents the horizontal position on the display.

Write Ramp Generator: (IC7)

Write address data from IC5 is converted to an analog ramp for the RF sweep by RF ramp digital-to-analog converter IC7 and IC9D. The amplitude and position of the ramp are controlled by operational amplifier IC9A. The RF ramp is coupled through the display switch to control the spectrum analyzer sweep oscillator.

Display Clock Generator: (Q1203 & Q1204)

The display clock generator is similar to the write clock generator. The difference is that the display clock runs at a constant rate, of about 15,360 Hz. Ramp generation is also similar to that for the Write Ramp, using IC's 6, 8, and 9B & C.

Display Binary Counter: (IC6)

The display binary counter converts the display clock input to ten-bit binary address information. During the memory read cycle, the memory address is determined by the display counter.

Display Ramp Generator: (IC8)

Read address data is converted to an analog ramp by the display ramp generator. Amplitude and offset are controlled to make the display ramp position and amplitude the same as the ramp used in the analyzer. During STORE and FREEZE operation, the horizontal position of the analyzer display is determined by the display ramp.

Blanking Generator: (IC18A & B)

Blanking is generated by processing the display ramp. The blanking signal turns the display off during the time the analyzer is retracing.

Address Multiplexer (MUX): (IC1, 2, 3, & 4)

The address multiplexer provides either the read or write address for memory Input/Output operation. The multiplexer is composed of four three-state buffers. The buffer state is controlled by two waveforms from the timing logic generator through IC11A. The one waveform through IC11A is inverted through IC11C to get the other waveform.

Timing Clock: (IC16)

All memory control timing originates from the timing clock (IC16) which runs at approximately 1 MHz.

Timing Logic Generator: (IC14)

The timing logic generator consists of binary counter IC14, five-diode OR gate (CR1201--1205), and eleven two-input NAND gates (IC's 11, 12, and 13). The binary counter converts the gated timing clock to a six- bit binary code. Timing logic circuit outputs go to: Address Select IC's 1--4; Pre-start Convert IC42 pin 4; Read/Write circuit IC28--31, and De-glitch circuit IC17C.

5. ALIGNMENT

Introduction:

The DS-9 is aligned at the factory. However, occasional minor adjustments may occasionally be necessary because of aging and shifting of components. The following sections describe adjustments which may be conveniently performed in the field. The spectrum analyzer must operate properly in the normal mode before you do any adjustments on the DS-9 circuit.

Equipment Required:

You will need the following:
POWER SOURCE capable of 12 to 15 VDC at 2.0 amperes (use the charger/-converter supplied with the spectrum analyzer, as long as it is operating correctly).
VOLTMETER: Digital voltmeter or VTVM.
OSCILLOSCOPE: Tectronix 545 or equivalent.

Low Voltage Power Supply Adjustment:

When the analyzer is in the Store mode, there are four voltages available on the DS-9 board. The analyzer supplies +11.3 VDC which is used to produce +10, +5, and -6.5 VDC. These voltages are based on the +11.3 and are not adjustable. If the 11.3 VDC is out of tolerance, refer to the analyzer alignment section. If the 11.3 VDC is correct but any of the other voltages are out of tolerance, troubleshoot that part of the supply.

LOCATION	VOLTAGE
IC 23 (LM330T), pin 1	11.3± .1 VDC
IC 23 (LM330T), pin 3	10.0± .2 VDC
Emitter of Q1205	5.0± .1 VDC
Test Point between C1214 and C1216	-6.5± .5 VDC

Amplitude Adjustment:

The signal amplitude on the display should be the same whether in the storage mode or in the normal display mode. If the amplitudes do not match, perform the following adjustment.

1. Set the controls as shown below:

Phase Lock	Off
Disperson	1 MHz/Div
Resolution	200 kHz
Rate-Man	Adjust for approx. 15 Hz sweep rate
Divide-by-10	Off
Filter	Out

2. Supply a signal (at a convenient and useable frequency) to RF IN to give full scale deflection on the display (-30 dBm to the AL-51C; +20 dBmV to the VSM-2C; and +10 dBmv to the VSM-5).

3. Set the Display switch to NORM, and center the signal on the display. Adjust the width of the display with the Dispersion Vernier so that the base line shows on either side of the base line. This display will be used to set the amplitude and offset controls on the DS-9 circuit board.

4. Set the Display switch to STORE.

In the next steps you will adjust the following controls as required to match the Store display to the Normal display.

These controls will have immediate effect on the display:

R1241 --Vertical Output Offset (immediate)
R1251 --Vertical Output Gain (immediate)

These controls will have a delayed effect on the display because the voltage changes must be digitally processed and stored, then displayed on the screen during the next update. Adjust these controls slowly, noting their effect as the display is updated.

R1259 --Vertical Input Adjust (delayed)
R1256 --Vertical Input Offset (delayed)

5. Connect an oscilloscope probe to IC18 pin 8 and use R1259 and R1256 to adjust the signal voltage so that the maximum is at 7.6 volts and the minimum is at 3.7 volts.

6. Adjust R1251 and R1241 so that the amplitude and baselines do not move when you switch between the Normal and Stored displays.

Horizontal Display Adjustments:

Set the controls as indicated at the beginning of section 5.4. Adjust control R1214 to give 2.0 volts at the common connection of IC7 and 8, pin 15. Then center the display using R1232. Use R1224 to adjust the width of the display to 10 centimeters (the width of the graticule). Readjust R1232 as needed to keep the display in the center of the screen while adjusting the width.

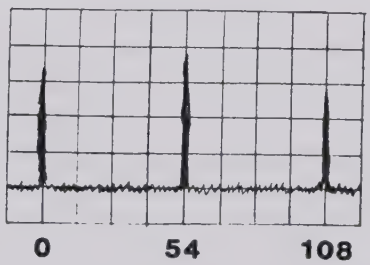
Dispersion Adjustment:

1. Set these analyzer controls as indicated:
   DISPERSION .....100 MHz
   RESOLUTION.....200 kHz
   RATE/MAN.....15 Hz
   NORM/STORE.....NORM

2. Connect the analyzer's CAL OUT signal to the RF IN connector.

3. Place the 54 MHz marker at the center of the analyzer's display.

4. Reduce the analyzer dispersion while keeping the 54 MHz signal in the center of the display, until the zero bell and the 108 MHz harmonic are placed as shown in the figure below.



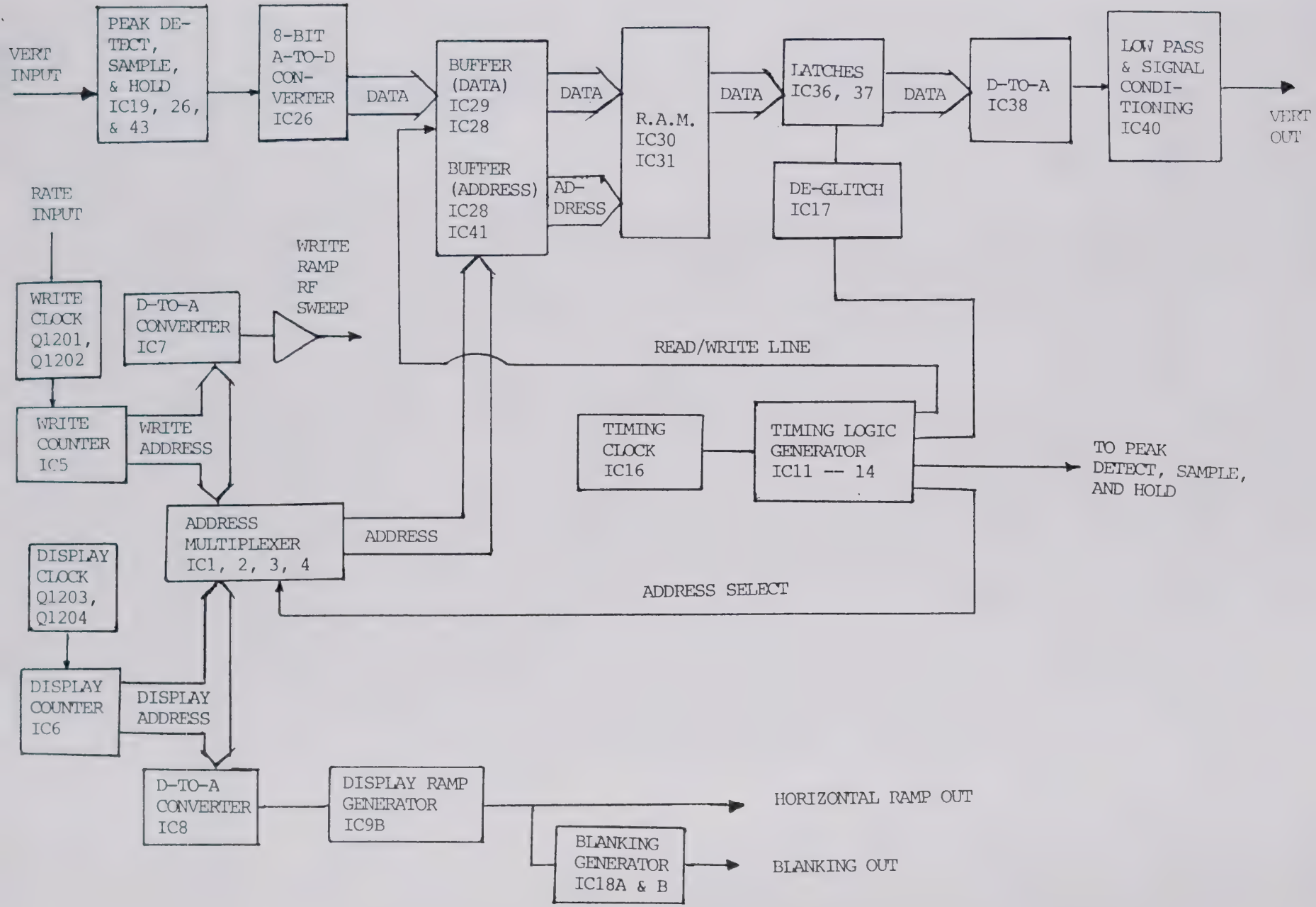
5. Switch from NORM to STORE.

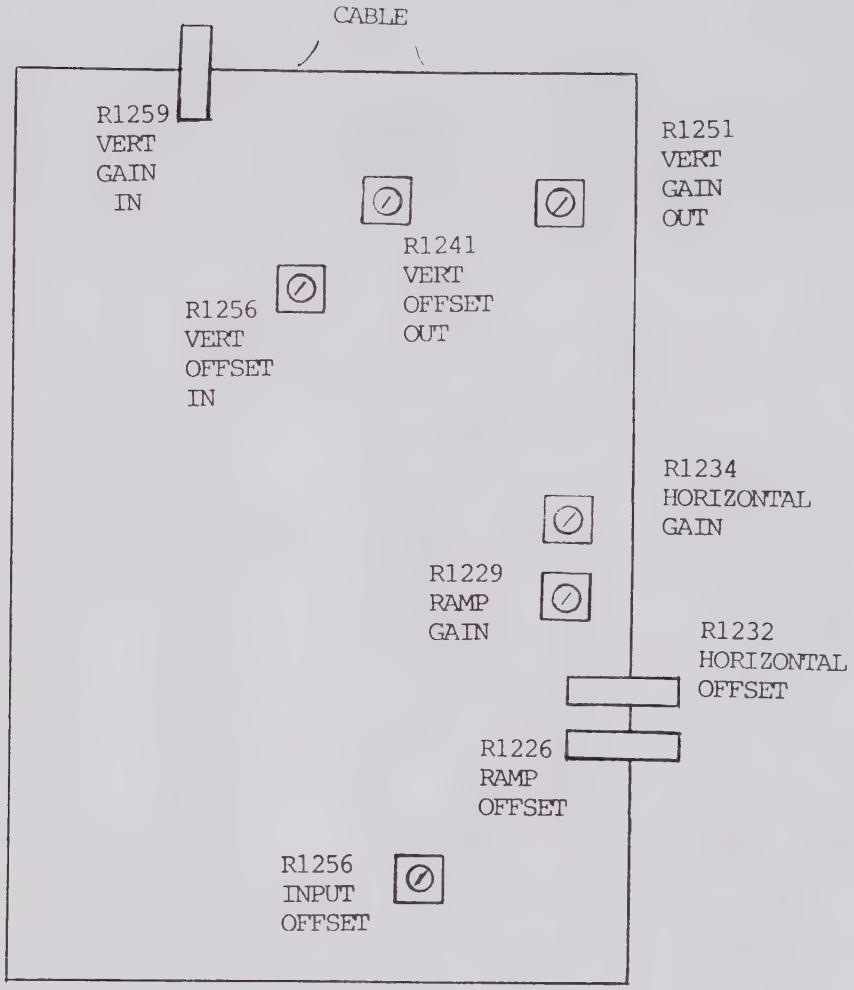
6. Adjust R1226 (RF ramp centering), if necessary, to place the 54 MHz peak in the center of the display. Then adjust R1229 (RF ramp amplitude) so that the zero bell and 108 MHz are again at the proper position with respect to the graticule.

7. Switch back to NORM again to compare the positioning on the display. If necessary, make small corrections to R1226 and R1229 until the two displays match.

6. APPLICATIONS

While the addition of digital storage to a spectrum analyzer does not increase the range of applications for an analyzer, it does make many applications more convenient. The primary value is in measurements requiring relatively slow sweep speed since the STORE function gives a stable, non-fading display. In addition, the FREEZE function can save a particular sweep for an indefinite period of time.


VERT INPUT
PEAK DE-TECT, SAMPLE, & HOLD IC19, 26, & 43
8-BIT A-TO-D CON-VERTER IC26
DATA
BUFFER (DATA) IC29 IC28
BUFFER (ADDRESS) IC28 IC41
DATA
AD-DRESS
R.A.M. IC30 IC31
DATA
LATCHES IC36, 37
DATA
D-TO-A IC38
LOW PASS & SIGNAL CONDI-TIONING IC40
VERT OUT
DE-GLITCH IC17
RATE INPUT
WRITE CLOCK Q1201, Q1202
D-TO-A CONVERTER IC7
WRITE RAMP RF SWEEP
READ/WRITE LINE
WRITE COUNTER IC5
WRITE ADDRESS
TIMING CLOCK IC16
TIMING LOGIC GENERATOR IC11 -- 14
TO PEAK DETECT, SAMPLE, AND HOLD
ADDRESS MULTIPLEXER IC1, 2, 3, 4
ADDRESS
ADDRESS SELECT
DISPLAY CLOCK Q1203, Q1204
DISPLAY COUNTER IC6
DISPLAY ADDRESS
D-TO-A CONVERTER IC8
DISPLAY RAMP GENERATOR IC9B
HORIZONTAL RAMP OUT
BLANKING GENERATOR IC18A & B
BLANKING OUT



COMPONENT LOCATION

PRINTED CIRCUIT BOARD FOR DS-9

Shown from the component side. You must remove the board from its mounting to reach the controls for adjustement.

Replacement Parts List - DS-9
Final Assembly - 206-265

Printed Circuit Board Sub-assembly - 206-241

Ckt.Ref.No.	Texscan P/N	Description
CAPACITORS		
C1201	012-403	110 pF, 300 v
C1202	012-068	100 pF
C1203	012-064	33 uF, 40 v
C1204	012-085	.005 uF
C1205	012-134	.05 uF, 100 v
C1206	012-009	1000 p, 500 v
C1207	012-268	.1 uF
C1208	012-309	.02 uF
C1209	012-050	.01 uF, 100 v
C1210	012-287	.47 uF, 35 v
C1211	012-085	.005 uF
C1212	012-523	.47 uF, 20 v
C1213	012-523	.47 uF, 20 v
C1214	012-523	.47 uF, 20 v
C1215	012-523	.47 uF, 20 v
C1216	012-268	.1 uF
C1217	012-276	10 uF, 25 v
C1218	012-050	.01 uF, 100 v
C1219	012-068	100 pF
C1220	012-009	1000 p, 500 v
C1221	012-009	1000 p, 500 v
C1222	012-064	33 uF, 40 v
C1223	012-060	100 uF, 16 v, electrolytic
C1224		
C1225	012-064	33 uF, 40 v
C1226	012-134	.05 uF, 100 v
C1227	012-297	1 uF
C1228		
C1229		
C1230		
C1231	012-297	1 uF
C1232	012-139	2700 pF, 500 v
C1233	012-138	1000 pF, 100 v
C1234		
C1235	012-163	.002 uF, 1000v
C1236	012-064	33 uF, 40 v
C1237	012-064	33 uF, 40 v
C1238	012-009	1000 p, 500 v
C1239	012-268	.1 uF
C1240		
C1241	012-268	.1 uF
C1242	012-009	1000 p, 500 v
C1243	012-523	.47 uF, 20 v

Printed Circuit Board Sub-assembly - 206-241 (cont.)

Ckt.Ref.No.	Texscan P/N	Description
DIODES		
CR1201	025-084	1N914
CR1202	025-084	1N914
CR1203	025-084	1N914
CR1204	025-084	1N914
CR1205	025-084	1N914
CR1206	025-044	1N4006
CR1207	025-044	1N4006
CR1208	025-044	1N4006
CR1209	025-044	1N4006
CR1210	025-084	1N914
CR1211	025-084	1N914
CR1212	025-133	1N751
CR1213	025-084	1N914
INTEGRATED CIRCUITS		
IC1	076-140	CD4503
IC2	076-140	CD4503
IC3	076-140	CD4503
IC4	076-140	CD4503
IC5	076-142	CD4040
IC6	076-142	CD4040
IC7	076-141	AD7533
IC8	076-141	AD7533
IC9	076-145	LM224
IC10	076-143	MM74C04
IC11	076-075	MC14011
IC12	076-144	MM74C08
IC13	076-144	MM74C08
IC14	076-142	CD4040
IC15	076-124	CD4001
IC16	076-178	ICM7555
IC17	076-124	CD4001
IC18	076-145	LM224
IC19	076-150	LF412
IC20	076-150	LF412
IC21	076-150	LF412
IC22	NOT USED	
IC23	Not on PCB, See "Miscellaneous"	
IC24	076-002	LM741
IC25	NOT USED	
IC26	076-146	ADC0800
IC27	NOT USED	
IC28	076-176	LS54LS367
IC29	076-153	54LS365
IC30	076-147	TC5514P-1
IC31	076-147	TC5514P-1
IC36	076-148	74C175
IC37	076-148	74C175
IC38	076-141	AD7533
IC40	076-145	LM224

Printed Circuit Board Sub-assembly - 206-241 (Cont.)

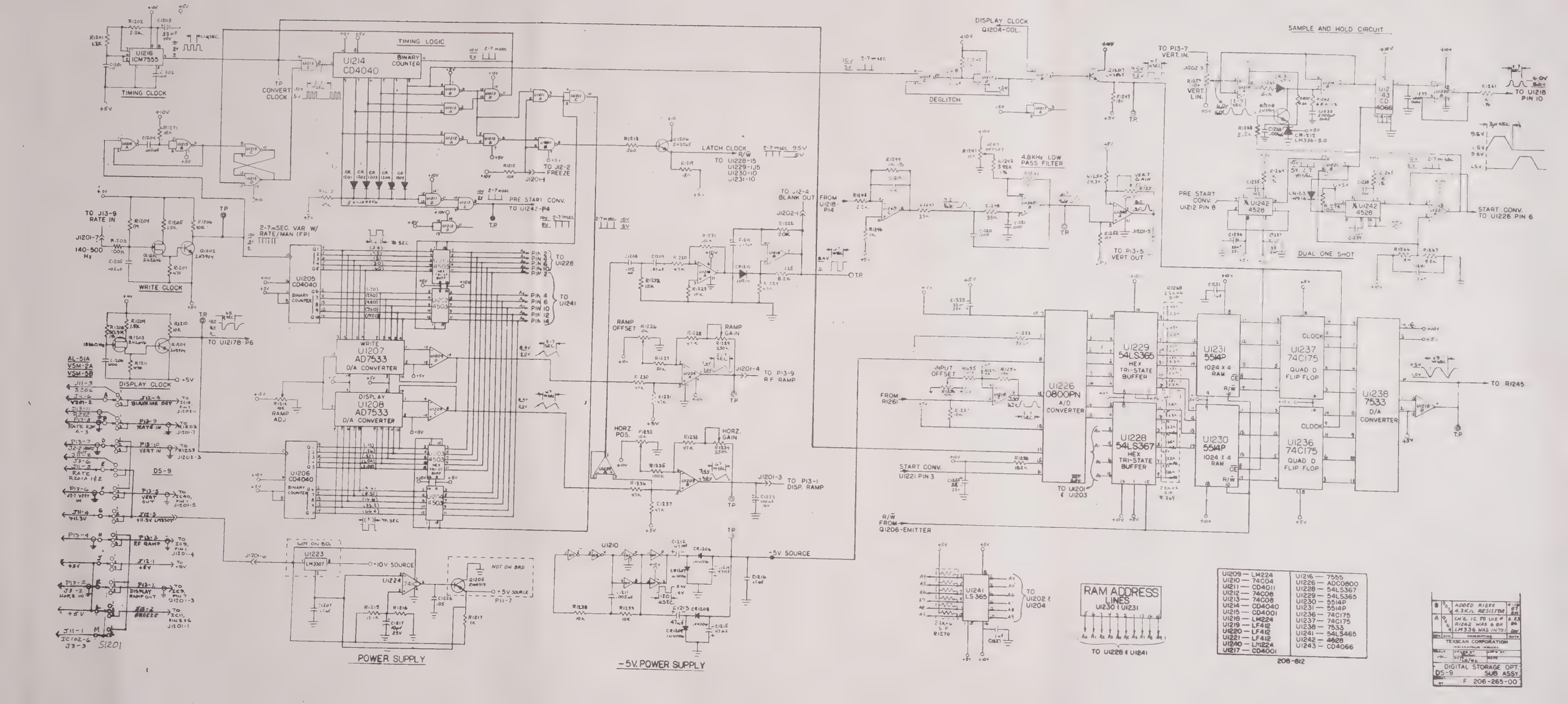
Ckt.Ref.No.	Texscan P/N	Description
INTEGRATED CIRCUITS (Cont.)		
IC41	076-153	54LS365
IC42	076-152	MC14528
IC43	076-151	CD4066
TRANSISTORS		
Q1201	062-166	2N2646
Q1202	062-083	2N3904
Q1203	062-166	2N2646
Q1204	062-083	2N3904
Q1205	Not on PCB, See "Miscellaneous."	
Q1206	062-002	2N3565
Q1207	062-002	2N3565
RESISTORS	(All are 1/4 watt, 5% unless marked otherwise)	
R1201	045-713	1200
R1202	045-723	2200
R1203	045-793	100 k
R1204	047-463	1 M, 1%
R1205	045-716	1500
R1206	045-751	10 k
R1207	045-695	470
R1208	047-069	100 k, 1%
R1209	045-716	1500
R1210	045-751	10 k
R1211	045-695	470
R1212	045-751	10 k
R1213	045-779	47 k
R1214	048-247	10 k, 20%, Variable
R1215	045-755	12 k
R1216	045-751	10 k
R1217	045-709	1000
R1218	045-699	560
R1219	045-678	180
R1220	045-779	47 k
R1221	045-793	100 k
R1222	045-764	20 k
R1223	045-751	10 k
R1224	045-779	47 k
R1225	045-748	8200
R1226	048-161	10 k, Variable
R1227	045-801	150 k, 10%
R1228	045-779	47 k
R1229	048-256	250 k, Variable
R1230	045-779	47 k
R1231	045-779	47 k
R1232	048-161	10 k, Variable
R1233	045-779	47 k
R1234	048-256	250 k, Variable
R1235	045-793	100 k
R1236	045-779	47 k

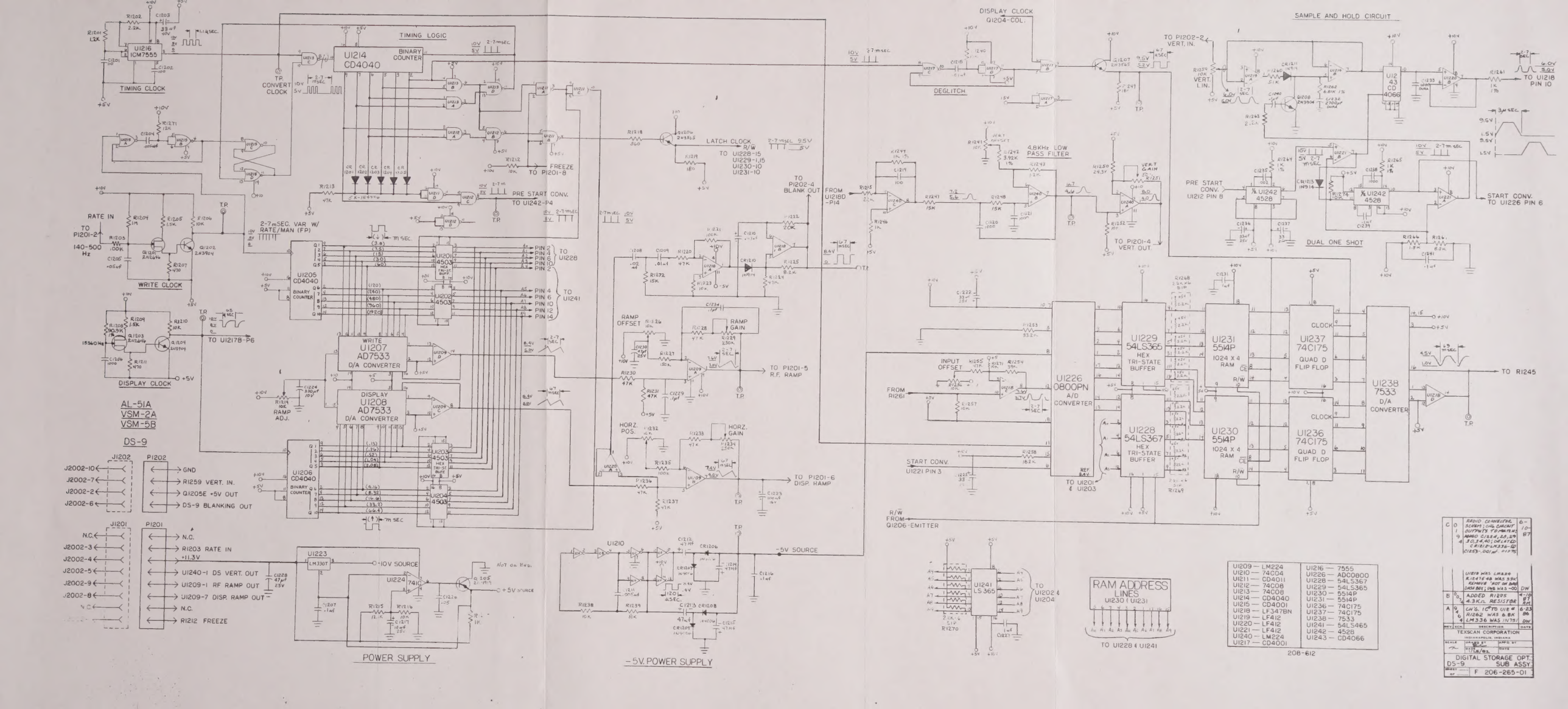
Printed Circuit Board Sub-assembly - 206-241 (Cont.)

Ckt.Ref.No.	Texscan P/N	Description
RESISTORS (Cont.)		
R1237	045-779	47 k
R1238	045-751	10 k
R1239	045-751	10 k
R1240	045-751	10 k
R1241	048-247	10 k, 20%, Variable
R1242	047-445	3920, 1%
R1243	045-713	1200
R1244	047-462	1000, 1%
R1245	045-723	2200
R1246	045-709	1000
R1247	045-772	33 k
R1248	045-772	33 k
R1249	045-678	180
R1250	047-675	24.5 k
R1251	048-253	50 k, 20%, Variable
R1252	045-751	10 k
R1253	047-444	33.2 k, 1%
R1254	045-776	39 k
R1255	045-779	47 k
R1256	048-247	10 k, 20%, Variable
R1257	045-751	10 k
R1258	047-442	18.2 k, 1%
R1259	048-161	10 k, Variable
R1260	045-740	5100, 5%
R1261	047-462	1000, 1%
R1262	045-745	6800
R1263	045-723	2200
R1264	047-462	1000, 1%
R1265	047-462	1000, 1%
R1266	045-716	1500
R1267	045-748	8200
R1268	083-008	2200, resistor network
R1269	083-008	2200, resistor network
R1270	083-008	2200, resistor network
R1271	045-751	10 k
R1272	045-758	15 k
R1273	045-751	10 k

Miscellaneous Parts (Not On Circuit Board)

IC23	076-177	LM330T
Q1205	062-053	2N4919 Transistor
S1201	057-260	12P/3POS Switch
	042-090	Knob


TIMING CLOCK
U1216 ICM7555
TIMING LOGIC
U1214 CD4040
BINARY COUNTER
TP CONVERT CLOCK
LATCH CLOCK R/W
TO U1228-15 U1229-1,15 U1230-10 U1231-10
TO J12-2 FREEZE
J1201-4
PRE START CONV.
TO U1242-P4
TO J13-9 RATE IN
J1201-7 140-500 Hz
2-7mSEC. VAR W/ RATE/MAN (FP)
WRITE CLOCK
U1205 CD4040
BINARY COUNTER
TO U1228
TO U1241
WRITE U1207 AD7533 D/A CONVERTER
DISPLAY U1208 AD7533 D/A CONVERTER
RAMP ADJ
U1206 CD4040
BINARY COUNTER
DISPLAY CLOCK
TO U1217B-P6
AL-51A VSM-2A VSM-5B
DS-9
RAMP OFFSET
RAMP GAIN
TO P13-9 R.F. RAMP
J1201-4
HORZ. POS.
HORZ. GAIN
J1201-3
TO P13-1 DISP. RAMP
TO R1253
J1202-3
TO IC40, PIN 1 J1201-5
+11.5V
+11.5V LASSOP
NOT ON BD
U1223 LM3307
-10V SOURCE
U1224
Q1205 2N4919
+5V SOURCE
P11-7
POWER SUPPLY
U1210
-5V SOURCE
-5V. POWER SUPPLY
DISPLAY CLOCK Q1204-COL.
DEGLITCH
TO P13-7 VERT. IN.
VERT. LIN.
SAMPLE AND HOLD CIRCUIT
U1243 CD 4066
TO U1218 PIN 10
LM336-5.0
PRE START CONV. U1212 PIN 8
U1242 4528
START CONV. TO U1226 PIN 6
DUAL ONE SHOT
FROM U1218-P14
4.8KHz LOW PASS FILTER
VERT. OFFSET
VERT. GAIN
TO P13-5 VERT OUT
TO J12-4 BLANK OUT
J1202-1
U1226 0800PN A/D CONVERTER
U1229 54LS365 HEX TRI-STATE BUFFER
U1228 54LS367 HEX TRI-STATE BUFFER
U1231 5514P 1024 X 4 RAM
U1230 5514P 1024 X 4 RAM
U1237 74C175 QUAD D FLIP FLOP
U1236 74C175 QUAD D FLIP FLOP
U1238 7533 D/A CONVERTER
TO R1245
FROM R1261
INPUT OFFSET
START CONV. U1221 PIN 3
TO U1201 & U1203
R/W FROM Q1206-EMITTER
U1241 LS 365
TO U1202 & U1204
RAM ADDRESS LINES
U1230 & U1231
TO U1228 & U1241
U1209 — LM224
U1210 — 74C04
U1211 — CD4011
U1212 — 74C08
U1213 — 74C08
U1214 — CD4040
U1215 — CD4001
U1216 — LM224
U1219 — LF412
U1220 — LF412
U1221 — LF412
U1240 — LM224
U1217 — CD4001
U1216 — 7555
U1226 — ADC0800
U1228 — 54LS367
U1229 — 54LS365
U1230 — 5514P
U1231 — 5514P
U1236 — 74C175
U1237 — 74C175
U1238 — 7533
U1241 — 54LS465
U1242 — 4528
U1243 — CD4066
208-812
ADDED R1255 4.3K Ω RESISTOR
CHG. IC TO U1E # R1262 WAS 6.8K & LM336 WAS INT'L
TEXSCAN CORPORATION
DIGITAL STORAGE OPT. DS-9 SUB ASSY.
F 206-265-00


TIMING LOGIC
U1214 CD4040 BINARY COUNTER
U1216 ICM7555
TIMING CLOCK
TP CONVERT CLOCK
DEGLITCH
DISPLAY CLOCK Q1204-COL.
TO P1202-2 VERT. IN.
SAMPLE AND HOLD CIRCUIT
VERT. LIN.
VERT. OFFSET
4.8KHz LOW PASS FILTER
VERT. GAIN
TO P1201-4 VERT. OUT
PRE START CONV. U1212 PIN 8
DUAL ONE SHOT
START CONV. TO U1226 PIN 6
TO U1218 PIN 10
RATE IN
TO P1201-2 140-500 Hz
2-7mSEC. VAR W/ RATE/MAN (FP)
WRITE CLOCK
U1205 CD4040 BINARY COUNTER
U1206 CD4040 BINARY COUNTER
U1202 4503
U1203 4503
U1204 4503
HEX TRI-ST BUFF
TO U1228
TO U1241
WRITE U1207 AD7533 D/A CONVERTER
DISPLAY U1208 AD7533 D/A CONVERTER
RAMP ADJ.
TO U1218-P6
DISPLAY CLOCK
AL-51A
VSM-2A
VSM-5B
DS-9
J1202
P1202
J2002-10
J2002-7
J2002-2
J2002-6
GND
R1259 VERT. IN.
Q1205E +5V OUT
DS-9 BLANKING OUT
J1201
P1201
N.C.
J2002-3
J2002-4
J2002-5
J2002-9
J2002-8
R1203 RATE IN
+11.3V
U1240-1 DS VERT. OUT
U1209-1 RF RAMP OUT
U1209-7 DISP. RAMP OUT
R1212 FREEZE
POWER SUPPLY
U1223 LM330T
-10V SOURCE
U1224 741C
+5V SOURCE
NOT ON BD.
LATCH CLOCK R/W
TO U1228-15 U1229-1,15 U1230-10 U1231-10
FREEZE TO P1201-8
PRE START CONV. TO U1242-P4
FROM U1218D -P14
TO P1202-4 BLANK OUT
RAMP OFFSET
RAMP GAIN
TO P1201-5 R.F. RAMP
HORZ. POS.
HORZ. GAIN
TO P1201-6 DISP. RAMP
-5V SOURCE
-5V. POWER SUPPLY
FROM R1261
INPUT OFFSET
START CONV. U1221 PIN 3
U1226 0800PN A/D CONVERTER
TO U1201 & U1203
U1229 54LS365 HEX TRI-STATE BUFFER
U1228 54LS367 HEX TRI-STATE BUFFER
U1231 5514P 1024 X 4 RAM
U1230 5514P 1024 X 4 RAM
U1237 74C175 QUAD D FLIP FLOP
U1236 74C175 QUAD D FLIP FLOP
U1238 7533 D/A CONVERTER
TO R1245
R/W FROM Q1206-EMITTER
U1241 LS 365
TO U1202 & U1204
RAM ADDRESS LINES U1230 (U1231)
TO U1228 & U1241
U1209 — LM224
U1210 — 74C04
U1211 — CD4011
U1212 — 74C08
U1213 — 74C08
U1214 — CD4040
U1215 — CD4001
U1218 — LF347BN
U1219 — LF412
U1220 — LF412
U1221 — LF412
U1240 — LM224
U1217 — CD4001
U1216 — 7555
U1226 — ADC0800
U1228 — 54LS367
U1229 — 54LS365
U1230 — 5514P
U1231 — 5514P
U1236 — 74C175
U1237 — 74C175
U1238 — 7533
U1241 — 54LS465
U1242 — 4528
U1243 — CD4066
208-612
REVISIONS
DESCRIPTION
TEXSCAN CORPORATION
INDIANAPOLIS, INDIANA
DIGITAL STORAGE OPT. DS-9 SUB ASSY
F 206-265-01

MP MASTER
MA33148